The economic and environmental consequences of tariffs on electrical vehicles: A CGE analysis for US, EU and China

Master Thesis

Student's Name:	Somansh Chordia
MSc Programme:	Industrial Ecology
Student Numbers:	LU: 3970582 TU: 6110614
1st Supervisor:	Dr. Rutger Hoekstra
2nd Supervisor:	Dr. Roman Stöllinger
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Universiteit Leiden
The Netherlands

TU Delft

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Abstract

The global trade landscape is undergoing profound changes, driven by the re-emergence of tariffs with Trump's first administration in 2018 and the acceleration of the green transition. Among the industries affected is the electric vehicle (EV) sector, where traditional market leaders such as the US and EU face increasing competition from China. While economic blocs are resorting to tariffs in an attempt to reduce their dependency on China and strengthen their domestic industries, their broader economic and environmental consequences are unknown. This study investigates the economic and climate change consequences of increased tariffs imposed on EVs and their associated supply chains in the year 2022, using a Computable General Equilibrium (CGE) model to simulate trade scenarios involving the EU, US, and China.

The findings reveal while tariffs can reduce dependence on Chinese EVs and support domestic industries of countries imposing tariffs, they also slow EV adoption and undermine climate goals. In scenarios where all three regions impose 20% tariffs on EV imports, global EV adoption drops by 0.87%. This slowdown of shift to EVs from internal combustion engine (ICE) vehicles leads to over 1.85 Mt CO_2-eq. of additional emissions over the lifetime of vehicles. Over half of these additional emissions are due to the 2.5% drop in EV adoption in EU. The trade diversion away from China leads to China's market share in EU and US declining by over 70% and 18%, respectively. When tariffs are expanded to cover other inputs to the EV industry like batteries, critical minerals, and electronics, the EV sector is more adversely affected, resulting in a 1.2% decline in global EV adoption and a rise in associated emissions to 2.5 Mt CO_2-eq.

A complementary game-theoretic analysis of these scenarios helps explain the real-world tendencies of major economic blocs to impose tariffs. The results suggest that the United States is incentivized to impose tariffs as a means of strengthening its domestic EV industry while mitigating losses in EV sales. China, in turn, is motivated to retaliate in order to reduce the negative repercussions for its EV industry and to preserve its market share. By contrast, the European Union faces a more complex dilemma: although tariffs would support its domestic EV industry, they would also exacerbate the decline in EV adoption, making non-retaliation the more favourable strategy from a climate perspective.

This study offers policymakers critical insights into the economic and climate change impacts of tariffs on the EV industry and its supply chains. By quantitatively evaluating trade scenarios, it brings out the trade-offs between strengthening domestic industries and climate goals and helps anticipate its impact on other regions. The findings support more holistic decision-making by emphasizing the importance of integrating climate considerations into trade policy to ensure a balanced and effective EV transition.

Keywords: Electric vehicles, tariffs, computable general equilibrium, climate change, economic impacts.

Contents

1 Introduction

The transport sector is one of the largest contributors to global greenhouse gas (GHG) emissions and energy consumption. As of 2019, it was the fourth largest source of global Emissions and the largest energy-consuming sector in 40% of countries and second largest in most others (Jaramillo et al., 2022). Alarmingly, transport has also shown the fastest growth in emissions among end-user sectors (residential, services, industry and transport) since 2010. Within this sector, road transport is the dominant emitter, responsible for approximately 70% of transport-related emissions and more than 10% of total global Emissions. Consequently, decarbonizing road transport is a key strategy for countries aiming to meet their climate and environmental targets (Jaramillo et al., 2022).

Among various mitigation strategies, transitioning to low-emission vehicles is one of the most promising for several use cases. Electric vehicles (EVs), particularly when powered by renewable energy, offer substantial emissions reductions by not only eliminating tailpipe emissions but also achieving a significantly lower lifecycle carbon footprint compared to internal combustion engine (ICE) vehicles. Recognizing this potential, many governments have implemented several policies and incentives aimed at accelerating EV adoption (Patil et al., 2024). In the Stated Policies Scenario (STEPS), the global net emissions avoided by replacing ICE vehicles with EVs are projected to reach approximately 1.8 Gt CO_2-eq. by 2035. Since EVs remain in use for 10–20 years, these emission savings accumulate over time, growing each year as more EVs enter the fleet and displace ICE vehicles. (International Energy Agency, 2024).

However, the rapid growth of EV demand brings new challenges concerning the robustness and reliability of the global EV supply chain. This supply chain is heavily dependent on critical raw materials such as lithium, cobalt, and rare earth elements, the sourcing and processing of which are dominated by China (Ballinger et al., 2019). Amid rising geopolitical tensions, governments, especially in the United States (US) and the European Union (EU), have sought to diversify and secure their supply chains, often through protectionist trade measures such as import tariffs on EVs, batteries, and related components. Tariffs are taxes imposed on imported goods and are a common trade policy tool used to protect domestic industries or influence trade flows.

During the first Trump administration in 2018, the United States imposed a series of tariffs on Chinese goods, including an additional 25% tariff on top of the existing 2.5% on electric vehicles (EVs) and auto parts. These measures were enacted under Section 301 of the Trade Act of 1974, citing China's "unreasonable or discriminatory" practices related to technology transfer, intellectual property, and innovation (Office of the United States Trade Representative, n.d.). In response, China imposed retaliatory tariffs on U.S. car imports (Fifield, 2018). Since then, both countries have introduced multiple rounds of tariffs on a wide range of goods, including EVs, EV batteries, steel, aluminium, and other automotive components. In May 2024, the Biden administration further raised tariffs on Chinese EVs to 100%, a rate that remains in effect today (Office of the United States Trade Representative, 2024). Most recently, at the start of Trump's second administration, his reciprocal tariffs intensified trade tensions between the two countries (World Economic Forum, 2025).

In October 2024, the EU imposed countervailing duties on Chinese-made EVs, in addition to the existing 10% import duty on passenger cars. These countervailing duties varied for each producer and ranged from 7.8% to 35.3%. The primary motivation behind these duties was to address the unfair competitive advantage created by Chinese government subsidies for EV production. These subsidies were seen as undermining the competitiveness of domestically produced EVs in the EU and harming the local industry. Beyond this, the EU also recognized the strategic importance of the EV sector in terms of innovation, value added, and employment, which made it particularly sensitive to external market distortions (European Commission, 2024). But it's not just the EVs itself. EU also recognizes the vulnerability of EV supply chains due to reliance on very few countries with low governance rankings, mainly China. To tackle this, EU's Critical Raw Material Act (CRMA) is one of the initial steps with diversification of supply chain being one of the key focal points. The regulation requires that no more than 65% of the EU's annual consumption of each strategic raw material at any relevant stage of processing should come from a single third country (Draghi, 2024).

While these measures aim to enhance national supply chain security and economic competitiveness, they also pose significant risks. They can raise consumer prices of EVs, disrupt supply chains, slow down EV adoption, and undermine environmental goals (Fedoseeva & Zeidan, 2018).

Yet, the broader environmental and economic consequences of these trade measures remain insufficiently understood. Existing literature has either analysed the impacts of domestic policies on EV sector, or the impacts of tariffs on other sectors, but no studies has specifically investigated the implications of EV-related increased tariffs.

This research aims to fill this critical gap by examining the climate change and economic impacts of increased tariffs imposed on EV supply chain-related goods. This study evaluates multiple trade scenarios, focusing on the world's three major EV markets: US, EU, and China. Specifically, it assesses how such tariffs influence emissions and EV adoption.

By exploring the trade-offs and unintended consequences of tariff-driven protectionism, this study contributes to a more detailed understanding of the implications of trade policy on the transition to EVs. It offers timely insights for policymakers seeking to balance protecting domestic industry with environmental objectives.

The remainder of this report is organised as follows. Section 2 gives a short overview of existing relevant literature, and identifies the research gap, which leads to the formulation the research questions. Section 3 outlines the model used in this study and describes the methodological approach, including the disaggregation of the EV industry and the design of tariff scenarios. Section 4 presents the results, beginning with an overview of the initial situation and addresses the research questions. Section 5 discusses the key findings in relation to existing literature, Section 6 outlines the study's limitations, and Section 7 concludes the report.

2 Literature Review

While there are several studies that have focused on the environmental and socio-economic impacts of domestic EV-related policies like subsidies, investment incentives, infrastructure mandates, and other government interventions, very few have analysed the impact of international policies like tariffs. Among such studies, Coffin et al. (2024) examined the effects of global tariffs on Chinese exports of EVs, hybrids, and related parts. As a result of the tariffs, Chinese exports of EVs and hybrids to the EU and US fell by 53.4% and 62.9%, respectively. Production in the EU and US rose by 7.8% and 6.5%, while China's production declined by 3.4%. The EU's domestic EV share increased more than the US's, due to higher initial dependence on Chinese imports in 2022.

Other studies have analysed the impacts of tariffs but are not limited to EV-related tariffs. Lin et al. (2019) compared the global environmental and health impacts of free trade versus anti-trade scenarios. Free trade scenario assumes no tariffs whereas anti-trade scenario assumes an additional 25% tariffs on current tariffs. They found that the reduced production under the anti-trade scenario would lead to 9% reduction in global GDP and 6.3% reduction in CO_2 emissions. The US, Western Europe, and China would experience the highest impacts.

As Trump began imposing tariffs and other trade barriers on China in his first administration, it led to a US-China trade war and a rise in studies analysing the environmental and economic impacts of protectionist trade measures. Lu et al. (2020) and Liu et al. (2020) analysed multiple rounds and scenarios of US–China trade friction using CGE models. Their findings show that trade friction causes economic slowdowns and emission reductions in participating countries, with China's and the US's GDP falling by 0.21% and 0.08%, respectively. GHG emissions declined more significantly, by 0.68% in China and 0.37% in the US. Building on this work, Guo et al. (2025) employed a multi-regional CGE model that incorporates both trade and foreign direct investment (FDI) flows to evaluate the broader global impacts. Their results suggest that maintaining the 2019 tariff levels would marginally reduce global emissions by 0.3%, with larger cuts in China offset by increases in other developing countries due to trade diversion. In contrast, Yuan et al. (2023) found that even though in an extreme scenario of no trade between US and China would reduce global emissions by 1.2%, but when the trade is diverted to other countries, global emissions instead increase by 0.3-1.8%.

Partial equilibrium-based studies, focusing on US, highlight the impact of tariffs on automotive supply chains. The USITC (2023) found that tariffs under sections 232 and 301 substantially raised the price of motor-vehicle parts imports from China, by 24.5% in 2021, and roughly halved import values, while domestically produced parts prices rose only modestly, about 1.5%, thereby increasing input costs and lead times for vehicle manufacturers. Schultz et al. (2019) use regional input-output methods to simulate US light-vehicle markets under section 232 and estimate substantial potential declines in vehicle sales, over 1.3 million units in worst-case scenarios, underscoring the risk that tariffs can slow EV adoption and thus delay emissions reductions in road transport.

Focusing on the EU, Fedoseeva and Zeidan (2018) emphasized the importance of removing import tariffs on inputs for renewable energy production. They used a reduced-form demand model for EU-27 countries to show that lower import prices for intermediate inputs used in renewable energy production reduce the cost of green electricity and can shift demand away from fossil fuels. Their findings suggest that eliminating these tariffs could decouple economic growth from environmental harm despite a 1–4% increase in EU GDP. Although the study does not focus specifically on EV-related tariffs, it highlights how free trade can support progress toward the Paris Agreement and Sustainable Development Goals (SDGs). Similarly, Shapiro (2021) highlighted asymmetries in tariffs imposed on "dirty" and "clean" sectors can influence global emissions trajectories, arguing that harmonising trade barriers could reduce global emissions by 3.6%.

Recently, in anticipation of Trump's second administration, Boeters & Meijerink (2024) from the Netherlands Bureau for Economic Policy Analysis (CPB) used a CGE model to analyse the effects of US tariffs on the Dutch and European economies. They assessed hypothetical tariffs between U.S. and EU. They find that for the Netherlands and EU, the trade (both imports and exports) declines by about 0.2% associated with an in-crease in domestic production and export to other countries. Some sectors are impacted more than others, with machinery and equipment manufacturing (-6%), electronic and optical products (-5.7%), and vehicles (-5.3%) being the most impacted. Interestingly, these are also the three industries on which EV manufacturing industry depends the most for intermediate goods as inputs. EU's retaliatory measures have a limited effect on US economy but restricts trade with US and increases prices in US.

Several studies have examined the economic and environmental impacts of carbon tariffs. Larch and Wanner (2017) employ a multi-sector structural gravity model that incorporates sectoral heterogeneity in emissions intensity and production technology, with tariffs raising bilateral trade costs and inducing general equilibrium adjustments in production and consumption. Calibrated to GTAP data with sector-level CO_2 coefficients, their analysis decomposes emission changes into scale, composition, and technique effects, finding that carbon tariffs reduce global emissions primarily via composition effects, shifting production away from carbon-intensive sectors, while scale effects are smaller and technique effects minimal. Combining such tariffs with the Copenhagen Accord's national targets further lowers the carbon leakage rate from 13.4% to 4.1%. Egger and Nigai (2015), using a multi-country Eaton–Kortum model with an explicit energy sector, show that taxing domestic energy production yields larger global emission reductions than taxing energy inputs, largely due to reduced carbon leakage. Bohringer et al. (2015) apply a multi-region CGE model to energy-intensive, trade-exposed industries and find that carbon tariffs can raise intermediate input costs, reduce competitiveness in international market, and harm domestic output, with the magnitude of these effects depending on the carbon content of imported inputs and the export share of domestic production. Together, these studies highlight that while carbon tariffs can deliver significant emission reductions, their effectiveness and distributional consequences depend on sectoral characteristics, trade linkages, and policy design.

While most studies focused on impacts of increased tariffs, Caliendo and Parro (2012) used a multi-sector Ricardian trade model with sectoral input–output linkages to quantify the effects of NAFTA's tariff reductions. Their computable general equilibrium framework, also used as the basis for the model in this study, captures how tariff changes propagate through global value chains. The model also predicts substantial trade creation within the bloc, with intra-member trade rising by nearly 120%, underscoring how tariff reductions can markedly reshape trade patterns. They estimate that Mexico's welfare increased by 1.31% as a result of NAFTA's tariff cuts, compared to only 0.08% for the United States, and show that ignoring intermediate goods linkages underestimates the effect of tariff changes.

Overall, this body of literature offers three key insights that underpin the analysis presented in this thesis. First, tariffs and border measures generate complex, sector-specific, and economy-wide effects that simultaneously influence production patterns, trade flows, and territorial emissions. Second, the direction and magnitude of these impacts depend critically on underlying trade linkages and the structure of intermediate inputs, dynamics that are effectively captured by CGE and structural gravity models. Third, while protectionist policies may support domestic industry output, they often entail unintended environmental consequences, such as delayed technology adoption or the relocation of production to regions with higher emissions intensity.

Computable General Equilibrium (CGE) modelling remains the predominant tool in these assessments due to its capacity to integrate inter-industry linkages and simulate economy-wide economic and environmental impacts of trade policies. This study employs a FIGARO-based CGE framework, similar to the variant of the Caliendo–Parro model used by Boeters and Meijerink (2024), but with a focus on economic and environmental impacts of EV related tariffs. More details about the CGE model and the approach are explained in the methods section of this study.

2.1 Research Gap

Although a growing body of literature examines domestic EV policies and the economic impacts of broader tariffs, there remains limited focus on EV related tariffs, and particularly their environmental consequences. This gap is especially important because EVs represent one of the most prominent technologies driving the transition toward a sustainable future. Yet, the potential of tariffs to slow EV adoption, by increasing costs or disrupting supply chains, is not integrated into existing assessments. Moreover, a comprehensive analysis of impacts of tariffs on EV adoption must extend beyond finished vehicles to include critical upstream components such as batteries, rare earth materials, and electronics. These sectors have been among the targeted industries in recent tariff interventions and have the potential to significantly influence both climate change and economic outcomes.

This thesis seeks to fill this important gap by exploring the climate change and economic impacts of increased tariffs on EV supply chain-related goods and assessing how these measures affect the adoption of EVs in the three major global markets for EVs, EU, US, and China. By doing so, it aims to provide a deeper understanding of the implications of trade policy on EV transition and associated climate change impact.

2.2 Research Questions

Based on the focus of this study and the research gap identified, the research questions can be formulated as follows:

Main research question:
What are the climate change and economic impacts of increased tariffs on EV supply chain related goods and how does it impact the adoption of EVs in EU, US, and China?

Several tariff scenarios, grounded in recent geopolitical developments, will be analysed to assess these impacts. The analysis will specifically examine changes, at global and regional level, in emissions due to change in EV sales, territorial GHG emissions, value added (VA), and trade patterns (exports and imports). These are the impacts studied in the following sub-research questions.

Sub-research questions:
1. What are the global and regional economic and climate change impacts of EU and US imposing tariffs on Chinese EV exports with China retaliating?
2. What are the global and regional economic and climate change impacts of decisions related to level of tariffs, industries included, and regions participating?

To answer the first sub-research question, a counterfactual scenario is considered where EU and US increase tariffs on Chinese EV by 20% and China retaliates with an equal increase in tariffs. To analyse the impact of these trade policy decisions, multiple scenarios with varying tariff levels and retaliation responses are simulated and compared. A detailed description of these scenarios is provided in Section 3.4.

3 Methods

3.1 Overview

The model used to evaluate trade policies is based on the quantitative general equilibrium framework developed by Caliendo and Parro (2015), hereafter referred to as the C&P model. It was selected for its balance between operational feasibility and structural detail, making it well-suited to capture the key trade-related mechanisms relevant to this analysis. In the model, production operates under constant returns to scale in perfectly competitive markets, utilising labour and intermediate goods as inputs. Price adjustments are captured by allowing industry and region-specific goods prices to vary in response to policy shocks. Trade patterns are determined by sectoral productivity differences and comparative advantage, with producers sourcing from the lowest-cost suppliers in accordance with Ricardian trade theory. Households maximise utility through a Cobb–Douglas function, which governs their expenditure shares across goods. Sectoral trade balances are determined endogenously, while each country's aggregate trade deficit is treated as exogenous.

It is important to note that the shares of value added and emission intensity for each industry are treated as exogenous variables in the model and vary proportionally with gross output.

The model computes changes in a counterfactual scenario relative to the baseline. For calibration, the input data is mainly based on three sources:

1. Trade and value-added data are taken from the 2022 FIGARO input–output table, which was the latest available when the analysis was conducted. Although 2023 data were released before publication, they became available only after the analysis was completed.
2. Tariff data comes from United Nations Conference on Trade and Development (UNCTAD) Trade Analysis Information System (TRAINS) database
3. Sectoral elasticities of substitution are taken from Freeman et al. (2022)

FIGARO database, which is the outcome of a collaborative project between Eurostat and the Joint Research Centre of the European Commission (Eurostat, 2021), is preferred over the commonly used GTAP database due to its detailed focus on the European Union and its main trading partners, as well as its more recent temporal coverage.

The UNCTAD TRAINS database, accessible through World Integrated Trade Solution (WITS), provides tariff data for over 160 countries at the 6-digit HS product code level. To integrate this data into the C&P model, both the regions and products must be mapped to the corresponding region and industry classifications used in the FIGARO framework (WITS - About WITS, n.d.).

The elasticities of substitution for each sector reflects how easily goods from different countries can substitute for each other when relative prices change due to tariffs. A higher elasticity means trade flows adjust strongly to small cost changes. The C&P model uses dispersion parameter for each sector as an input while finding the new equilibrium. It assumes that the productivity of sectors in countries follow a Fréchet distribution and the dispersion parameter indicates the "spread" of the distribution. It represents the notion of comparative advantage between countries. The substitution elasticities used in this analysis are taken from Freeman et al. (2022). The corresponding dispersion parameters are derived by subtracting one from each substitution elasticity, as the elasticity of substitution is equal to the dispersion parameter plus one.

The original code provided with the Caliendo and Parro (2015) paper was adapted to incorporate input–output tables, bilateral tariff data, and estimated dispersion parameters as inputs, to compute the counterfactual equilibrium results.

The FIGARO database also provides emissions-related extensions, which will be used to translate changes in the economic values of outputs and trade into corresponding climate change impacts.

3.2 Disaggregation methodology

Since the focus is on EV industry, it is important to isolate manufacture of EVs as a separate industry. FIGARO's C29 industry "Manufacture of motor vehicles, trailers and semi-trailers" was disaggregated into "Manufacture of electric vehicles" and "Manufacture of motor vehicles, trailers and semi-trailers except electric vehicles" based on the approach outlined by Leurent and Windisch (2015). These are referred to as EV and non-EV industry. The EV industry was assumed to produce only final goods and no intermediate goods. The disaggregation steps are explained in detail in the Appendix A. The existing tariffs and elasticity of substitution associated with the new EV industry is assumed to be the same as the original C29 industry.

3.3 Estimating avoided emissions from change in EV sales

The C&P model provides bilateral trade flows and relative price changes, which can be used to calculate the change in the value of EV trade. However, to estimate the change in EV sales (quantities), the value per EV is required. For this, UN COMTRADE data (UN Comtrade, n.d.) on trade value, quantity, and weight was used. To address inconsistencies and unrealistic entries in the trade data, only transactions with a weight per EV between 1000 and 2500 kg were considered. The average value per EV from these filtered entries was then used to convert trade values into quantities. Combining this with the relative price change output from the model allowed for estimating the percentage and absolute change in EV sales in each region.

If we assume that the decrease in EV sales due to tariffs is offset by an equal increase in ICE vehicles sales, we estimate the missed emission savings by multiplying the reduction in EV sales by the lifecycle emission benefits of EVs over ICE vehicles. These benefits vary regionally, depending on factors such as the local grid's emissions intensity, average lifetime driving distance, and ICE vehicle fuel economy. For a medium-sized EV, the estimated lifetime emissions savings compared to an ICE vehicle are approximately 50 tonnes of CO_2-eq in the US, 20 tonnes in the EU, and 10 tonnes in China. The higher savings in the US result from a combination of higher annual mileage and faster projected power sector decarbonisation, whereas the lower savings in the EU are primarily due to lower mileage, and even lower in China due to higher emission intensity of the local grid (International Energy Agency, 2024). These values are used to translate modelled reductions in EV adoption into missed emission savings.

It is important to note that vehicle emissions occur across different stages of the lifecycle, namely car production, battery production, well-to-tank, and tank-to-wheel. The lifetime emission savings figures above account for differences across all these stages. However, in the context of territorial emissions, only tank-to-wheel emissions, from fuel combustion in ICE vehicles, and well-to-tank emissions, from electricity generation, distribution, and charging losses for EVs, contribute to the territorial emissions of the region where the vehicle is used. Emissions from other stages typically occur in other regions, depending on the geographical distribution of upstream supply chain activities.

3.4 Scenarios

The scenarios assessed in this study are shaped by ongoing geopolitical tensions and the strategic importance of the EV sector. Each scenario is defined by four key elements: (1) the countries imposing tariffs, (2) the target industries and countries, (3) the tariff rates, and (4) whether the targeted countries retaliate.

Given growing concerns in major EV economies, particularly the EU and US, regarding competition and dependence on China, the scenarios model different combinations of the EU and US imposing tariffs on Chinese goods, with and without Chinese retaliation.

In recent years, trade measures have extended beyond finished EVs to include upstream sectors such as batteries, critical raw materials, and electronic components. These industries are vital to the resilience and competitiveness of domestic EV supply chains. Thus, this study includes scenarios where tariffs are applied either solely on EVs or more broadly expanded to include key industries important for EV production.

Tariff levels in the scenarios increase by either 10% or 20% and all the participating regions increase their tariffs by the same level. While recent tariff measures by the EU and US on Chinese EVs have reached much higher levels, the 10% and 20% tariff increase scenarios used in this study serve as incremental policy shocks to facilitate clearer analysis and interpretation. These levels allow us to examine the direction and magnitude of economic and climate change impacts under relatively moderate yet politically realistic protectionist measures, without being overly influenced by extreme or temporary policy decisions. Moreover, using these more moderate tariff levels helps to avoid instability in the computable general equilibrium (CGE) model that could arise from large, abrupt shocks.

Table 1 summarizes the set of policy levers considered across scenarios, capturing the range of plausible trade actions and responses relevant to the current geopolitical landscape.

Table 1. Possible options for each element of new tariff that are combined to generate unique scenarios

New tariff element	Possible options
Importing-exporting region combinations	EU-China / US-China / EU&US-China
Industries tariffs are imposed on	EV manufacturing / EV supply chain related
Tariff levels increase	10% / 20%
Retaliation	Yes / No

The baseline scenario represents the scenario with all existing tariffs. Building on this, 24 counterfactual scenarios are constructed by combining the different policy elements described above. Among these, one scenario is designated as the main policy scenario: the EU and US impose 20% tariffs on Chinese EV imports, and China retaliates. This scenario is primarily compared with the baseline to address the first research question, which examines the overall impact of trade tensions in the EV sector.

To address the second research question, which explores the influence of individual policy choices, the 24 counterfactual scenarios are compared in pairs, where each pair differs in only one policy element (e.g., level of tariff, retaliation, or sector coverage). This design allows for isolation of the effect of each policy decision. By examining the consistent differences in results across multiple such comparisons for each element, the study identifies the specific impact of that element.

4 Results

This section presents the results of the CGE model simulations for each tariff scenario. We begin with an overview of the baseline scenario, which provides context for interpreting the outcomes of the policy scenarios. Next, we compare the main policy scenario to the baseline to assess the overall impact of EV-related tariffs on key economic and climate change indicators. Following this, we apply game theory principles to explore the strategic behaviour of each region in deciding whether to impose tariffs. Finally, recognizing that tariff policy involves more than just the decision to impose tariffs, we analyse the effects of individual policy choices by comparing scenarios.

4.1 Overview of the initial situation

This section presents an overview of the baseline scenario, detailing key aspects of the regional economies, existing tariffs on EV imports, and the trade relationships between the three focus regions.

Regional economies:

Table 2 summarizes the size of the regional economies, their EV industries, and their climate change impact measured by territorial GHG emissions. Although the US has the largest economy, China emits more than three times as much, reflecting the higher emission intensity of its industries, including the EV sector. The global EV industry's value-added amounts to 75.7 billion EUR, with China accounting for over 50%, highlighting its dominance in EV manufacturing.

It is also important to note that the EV industry accounts for less than 0.25% of the overall economy and contributes an even smaller share to total GHG emissions. Moreover, since the EV industry does not produce intermediate goods, changes within it do not propagate downstream through the supply chain. As a result, while tariffs on EV imports may affect regional EV industries, their impact on the broader economy is expected to be minimal.

Table 2. Size of regional economies, domestic EV industries, and associated territorial emissions. Source: FIGARO database (2022)

Metric	Units	EU	US	China
Total VA	trillion EUR	14.7	23.9	16.1
Total GHG emissions	billion tonne CO_2-eq.	2.9	4.8	14.2
EV VA	billion EUR	18.7	10.9	39.0
EV GHG emissions	million tonne CO_2-eq.	0.8	0.4	2.0

EV sales and sourcing pattern:

In 2022, 10.71 million EVs were sold globally. China not just dominates EV manufacturing, but is also the biggest market for EVs, and accounts for almost 60% of global EV sales. Table 3 presents the EV sales and sourcing patterns of EV imports for the EU, US, and China.

When EV imports are subjected to tariffs, a decline in EV sales is anticipated in countries implementing tariffs, particularly where there is significant reliance on imports from the targeted trade partner. Considering the greater dependence of EU on Chinese EV imports than the US, in terms of both percentage and quantity, a sharper decline in EV sales is expected in the EU when tariffs are imposed on China. Conversely, as China largely fulfils its EV demand through domestic production, retaliatory tariffs by China are not expected to significantly affect its domestic EV sales.

Table 3. EV sourcing patterns (% of total EV quantity) for the EU, US, and China in 2022. Source: Author's analysis based on Ndubuisi and Stöllinger (2024).

Exporting region	Importing region		
	EU	US	China
EU	83.63%	6.73%	0.24%
US	1.08%	81.63%	0.03%
China	5.47%	1.05%	99.69%
RoW	9.82%	10.59%	0.04%
Total (million)	1.90	1.23	6.25

Note: Imports from all other regions are aggregated under Rest of World (RoW). The last row shows total sales in each region (million units).

EV exports:

To assess the impact of tariffs on domestic EV industries, it is essential to consider export patterns. As shown in Table 4, only a small proportion of EVs from the EU and US are exported to China, and vice versa. Therefore, even if tariffs reduce bilateral trade, the overall impact on trade flows and domestic EV industries in these regions is likely to be limited. In contrast, although exports account for a relatively small share of China's total EV production, China's dominant position in global EV manufacturing means that its exports represent a significant share of EV sales outside China. As a result, when the two largest markets impose tariffs on Chinese imports, a notable decline in China's EV exports can be expected.

Table 4. EV exporting patterns (% of total EV quantity) for the EU, US, and China in 2022. Source: Author's analysis based on Ndubuisi and Stöllinger (2024).

Importing region	Exporting region		
	EU	US	China
EU	79.39%	1.79%	1.56%
US	4.15%	87.3%	0.19%
China	0.74%	0.19%	93.46%
RoW	15.72%	10.72%	4.79%
Total (million)	2.00	1.15	6.66

EV tariffs:

Table 5 presents the tariffs imposed on EVs by the regions under study on one another in the year 2022. Since the scenarios in this study involve a uniform percentage increase in tariff levels, and the relative changes are the primary drivers of outcomes, the absolute initial tariff levels do not directly influence the comparative results. However, it is important to highlight that, as of 2022, China already imposed significantly higher tariffs on EV imports from the EU and the US than vice versa. In the scenario with a 20% tariff increase, China's tariffs on EV imports would approach nearly 35%.

Table 5. Tariffs on EVs imposed by EU, US, and China on each other in 2022. Source: UNCTAD TRAINS database (2022)

Importing region	Exporting region		
	EU	**US**	**China**
EU	0	2.4-10.5	2.6-10
US	3.8-10.6	0	8.3
China	12.4-14.8	14.5	0

4.2 Impact of tariffs

We begin by analysing the scenario in which both the EU and the US impose additional 20% tariffs on EV imports and China retaliates. The effects on the key metrics of baseline are presented in Table 6.

Table 6. Impact on key baseline metrics (in percentage terms) when EU and US impose additional 20% tariffs on Chinese EV imports and China retaliates with equal increase in tariffs. Source: Author's analysis, model results.

Metric	Global	EU	US	China
EV sales	-0.87	-2.5	-0.3	+0.3
EV VA	+0.01	+0.85	+0.47	-0.78
EV emissions	-0.02	+1.12	+0.46	-0.78
Total VA ($\times 10^{-4}$)	0	+18.1	+5.8	-30.9
Total emissions ($\times 10^{-4}$)	-10.6	+3.1	+2.6	-19.9

Impact on EV trade:

Tariffs lead to notable shifts in EV trade patterns, even though total EV sales change only slightly across the three regions. As expected, the decline in sales is more pronounced in the EU (2.5%) than in the US (0.3%), while China, unexpectedly, records a modest increase of 0.3%. In the model, EV sales quantities are driven by changes in bilateral trade flows, relative prices, and baseline sourcing patterns. Of these, only trade flows and prices are endogenous to the CGE model, with changes in trade flows typically exerting a far greater influence than price changes.

The observed trade effects can be explained by the Ricardian trade framework underlying the C&P model (Eaton & Kortum, 2002). Producers source from the lowest cost suppliers, with sourcing decisions determined endogenously. When tariffs increase bilateral trade costs, goods from affected countries become more expensive relative to alternatives, leading to trade diversion, a reallocation of demand away from high-tariff partners toward third-party countries and domestic suppliers. Such diversion is particularly strong in equilibrium models with gravity-type trade equations, like the C&P model. Consequently, bilateral trade between tariff-imposing countries falls sharply, while imports from unaffected countries and domestic production rise, though usually to a lesser degree.

In the present scenario, higher tariffs between the EU/US and China substantially reduce Chinese EV exports to these markets. However, neither the EU nor the US can fully replace these imports with EVs from other countries or domestic suppliers, resulting in an overall decline in EV sales. In contrast, China is far less affected: with 99.69% of EVs sold domestically already produced in China (Table 3), even a slight redirection of production from export to domestic markets offsets the loss of EU and US imports, leading to stable or slightly higher domestic sales despite reduced overall production.

From a sourcing perspective, the most visible shifts occur away from countries whose exports faced higher tariffs toward domestic suppliers, whose market share rises the most in the EU and US due to their already dominant role (over 80% of EV demand). One of the key motivations behind the tariffs, from the EU and US perspective, is to reduce dependence on Chinese EVs. This goal is partly realised, as the market share of Chinese EVs in the EU and US drops by over 70%, and their overall share outside China falls by 1.3%. While this change appears modest in global market share terms, it is equivalent to a nearly 18% reduction in Chinese EV exports (Table 7).

Table 7. Market share of Chinese EVs in each region in baseline and the main scenarios. Source: Author's analysis, model results.

	Market share of Chinese EVs (%)	
Region	**Baseline**	**Counterfactual**
EU	5.47	1.58
US	1.05	0.23
World (except China)	9.76	8.04

Globally, EV adoption declines by nearly 0.9% (Table 8). However, this aggregate figure masks important regional differences, as the global decline is partially offset by increased EV adoption in China, which alone accounts for around 60% of global EV sales. When China is excluded, the drop in EV sales exceeds 2.5% (Table 8). As EVs become more expensive in the three major markets, overall demand falls due to household expenditure constraints and substitution effects toward other products, including ICE vehicles. Chinese EVs also held a substantial market share abroad; thus, reduced production in China, combined with a greater share of output being retained for its domestic market, contributed to lower EV sales in other countries. This highlights that tariff wars between major economies rarely remain confined to the countries involved, often producing broader repercussions for global technology adoption and associated emissions.

Table 8. Change in EV sales in the main scenarios. Source: Author's analysis, model results.

	Change in EV sales	
Region	**Percentage**	**Quantity**
EU and US	-1.63	50,970
World (except China)	-2.51	112,217
World	-0.87	92,851

Emissions associated with EV sales:

Assuming that the global decline in EV sales is offset by a corresponding increase in ICE vehicle sales, this would result in an additional 1.85 million tonnes (Mt) of CO_2-equivalent emissions over the lifetime of the vehicles, based on the methodology detailed in Section 3.3. Over half of these additional emissions, about 1 Mt CO_2-eq., are attributed to the 2.5% decline in EV adoption within the EU. While the emissions avoided per EV were highest in the US, the total additional emissions there were comparatively lower, at 0.17 Mt CO_2-eq., due to a smaller decline in EV sales. Conversely, the increase in EV sales in China resulted in an estimated emission saving of 0.2 Mt CO_2-eq. However, despite China's high baseline EV sales, the overall emission savings remained modest due to a relatively small increase in EV sales and lower per-vehicle emission savings.

These additional emissions, spread over the vehicle's lifetime, underscore the critical issue of carbon lock-in. A drop in EV adoption in a single year can have long-lasting effects, as the resulting increase in ICE vehicle use continues to generate emissions for the next 10–20 years. Even if EV adoption rebounds the following year, the emissions from that one-year setback persist.

EV sector specific effects:

The VA of the EV industry in the EU, US, and China changes only marginally, by less than 1%, across the modelled scenarios. While the EU and US EV industries experience slight gains, the Chinese EV industry shows a modest decline.

These changes can be explained by the underlying assumptions of the CGE model, particularly the Ricardian trade framework, in which producers source inputs from the lowest-cost suppliers. As a result, when two countries impose tariffs on each other, bilateral trade between them declines significantly, while imports from third-party countries and domestic trade tend to rise slightly due to trade diversion.

In the present case, exports from the EU and US to China fell sharply. However, this loss was more than offset by a modest increase in exports to other regions and domestic production. Since exports to China originally accounted for less than 0.75% of total exports from the EU and US, the overall impact was a net increase in gross output of their EV industries. Since value added shares and emission intensities are exogenous to the model, the relative change in each country's EV industry value added and GHG emissions mirrors the change in gross output. For the EU, emissions change slightly differently due to the use of a weighted sum of member countries.

In contrast, China's exports to the EU and US accounted for over 1.75% of its total exports. Although this share is still relatively small, the sharp reduction in these exports was not fully offset by increases in exports to other countries or domestic production. Consequently, China's EV industry experienced a slight decrease in gross output, value added, and emissions.

These opposing effects nearly cancel each other out, resulting in a negligible overall change in global EV industry value added, which increases by just 0.01%.

While tariff imposition may support the strengthening of domestic EV industries in the EU and US, it may simultaneously hinder overall EV adoption. In contrast, despite some negative effects on China's domestic EV industry, EV adoption within China is increased.

Targeted industry effects:

As expected, the VA of the EV industry exhibited the most significant change in each region, aligning with the overall direction of change in total VA. The magnitude of change in the EV industry's VA was roughly proportional to the total VA change, with the EU and China experiencing greater variations than the US.

Industry-level Emissions:

The most notable changes in emissions were observed in industries D35 (electricity and gas) and C24 (basic metals), both of which followed the overall trend in total emissions. The prominence of D35 is expected, as electricity and gas are essential inputs across nearly all upstream industries and exhibit some of the highest emission intensities in almost every region. In the case of C24, its crucial role in the EV supply chain, as shown in Table 14, explains its substantial emission changes. Although industries such as C27 (Electrical Equipment) and C29 (Motor Vehicles) constitute a larger share of the EV production structure, the emission intensity of C24 is orders of magnitude higher, resulting in a more pronounced shift in its emissions.

These emission changes were especially notable in China, driven by both the larger size of its EV industry and the relatively high emission intensities of its industrial sectors. However, despite the visible shifts, the relative change in emissions within each industry remained small when compared to their respective baseline emissions. Notably, the EV industry itself ranked among the top four contributors to the overall change in emissions.

Summary:

Imposing additional 20% tariffs on Chinese EVs by the EU and US, followed by China's retaliation, led to a global drop in EV adoption by 112,000 units, especially in the EU, resulting in 1.85 Mt CO_2-eq. of additional lifetime emissions due to increased ICE vehicle use. While domestic EV industries in the EU and US saw slight gains, the trade-off came at the cost of reduced EV uptake. Sourcing patterns shifted away from opposing trade partners toward domestic suppliers leading to China's market share in EV industry outside China dropping by 18%. Overall, the tariffs had limited economic benefits but notable environmental costs.

4.3 Game theory-based assessment

Having examined one particular scenario, where the EU and US impose additional 20% tariffs on Chinese EV imports and China responds with equivalent tariffs, it is important to consider that this outcome is only one of many possible results of the "tariff game." Given the interconnected nature of global trade and the significant role of these three major markets, a region can be affected by tariff changes between the other two even if it neither alters its own tariffs nor faces new ones. In other words, the impact on each region depends not only on its own policy choices but also on the strategies adopted by others.

For instance, in a scenario where all three regions impose tariffs, the EV industries in the EU and US benefit, while China's EV industry suffers. These results might lead Chinese policymakers to reconsider whether their EV sector will perform better if China chooses not to retaliate with tariffs. However, since the effect on China's EV industry also depends on the decisions made by the EU and US, this is not a decision that can be made in isolation. To determine the most beneficial strategy, each region must anticipate how the others will act in pursuit of their own self-interest. This is where game theory becomes a useful tool to understand strategic interactions and likely outcomes.

Two game theory concepts are particularly relevant here: a dominant strategy, which yields the best outcome for a player regardless of the choices of others, and a Nash equilibrium, a stable outcome where no player can benefit by unilaterally changing their strategy if others keep theirs unchanged. While such strategies or equilibria may not always exist, applying game theory still provides valuable insights into expected behaviour and strategic outcomes.

We assume that each region seeks to increase EV adoption and value added (VA) while reducing emissions. Since changes in VA and emissions tend to follow the same direction, strategies that maximise VA typically conflict with those that minimise emissions. However, this strong correlation allows us to simplify the analysis into two separate games, each focusing on a single objective:
Game 1: Maximise EV industry VA (and minimize EV emissions)
Game 2: Maximise EV sales (and associated emission savings)
Changes in total VA and GHG emissions are not analysed in detail as the maximum variation across scenarios is less than 0.005%.

Each of the three regions (EU, US, China) has two choices: to impose tariffs or not. For the EU and US, 'imposing tariffs' refers to introducing tariffs on imports from China. For China, it refers to retaliatory tariffs specifically targeting the region, either the EU or US, that imposes tariffs on Chinese goods. This creates 8 possible scenarios. However, the scenario in which only China imposes tariffs is excluded, based on the assumption that China retaliates only if tariffs are first imposed on it. Additionally, the baseline scenario—where no new tariffs are imposed—is used as a reference point. The remaining 6 scenarios form a subset of the 24 counterfactual scenarios described earlier, specifically those in which 20% tariffs are applied only on EVs.

The results for changes in EV VA and EV sales for each region in each scenario are presented using the normal form representation of a strategic game.

4.3.1. EV industry VA (% change).

Table 9. Normal form representation of the strategic game aimed at maximising EV industry value added (VA).

		EU does not impose tariffs						EU imposes tariffs					
		China						China					
		No tariffs			Tariffs			No tariffs			Tariffs		
US	No tariffs	0	0	0	-	-	-	2.27	0.05	-1.16	0.81	0.05	-0.65
	Tariffs	0.04	0.56	-0.17	0.04	0.41	-0.13	2.31	0.61	-1.33	0.85	0.47	-0.78

Note: Each cell shows the percentage change in EV VA for the three regions: yellow for EU, blue for US, and red for China. The strategies "No tariffs" and "Tariffs" represent the choices of not imposing or imposing tariffs, respectively. Nash equilibrium scenario is marked with a thick border.

In this game, the dominant strategy for all three regions is to impose tariffs. This means that, regardless of the decisions made by the other regions, each region maximizes the VA of its EV industry by choosing to impose tariffs. As a result, the Nash equilibrium corresponds to the scenario in which all regions impose tariffs.

It is important to highlight that, although China's EV industry performs worse in the Nash equilibrium scenario compared to some alternative scenarios where it does not impose tariffs, China cannot achieve those better outcomes unilaterally. Since the payoffs depend on the strategies of the other regions as well, China does not have an incentive to deviate from imposing tariffs if the EU and US continue to do so.

4.3.2. EV sales (% change).

Table 10. Normal form representation of the strategic game aimed at maximising EV industry value added (VA).

		EU does not impose tariffs						EU imposes tariffs					
		China						China					
		No tariffs			Tariffs			No tariffs			Tariffs		
US	No tariffs	0	0	0	-	-	-	-2.5	0	0	-2.3	0	0.3
	Tariffs	-1.2	-0.3	0	**-1.2**	**-0.3**	**0**	-2.5	-0.3	0	-2.5	-0.3	0.3

Note: Each cell shows the change in VA for the three regions: yellow for EU, blue for US, and red for China. The strategies "No tariffs" and "Tariffs" represent the choices of not imposing or imposing tariffs, respectively. Nash equilibrium scenario is marked with a thick border.

In this game, the dominant strategy for EU is to not impose tariffs, for China is again to impose tariffs, and US has no dominant strategy. Even though US does not have a dominant strategy, we have a Nash equilibrium, and it corresponds to the scenario in EU does not impose tariffs, but US and China do. In this scenario, EV adoption reduces by about 1.2% in EU and slightly increases in US and China.

Overall strategy.
In the Nash equilibrium of both games, US and China choose to impose tariffs. But EU encounters a strategic dilemma. While the Nash equilibrium that maximises EV industry's VA in EU involves imposing tariffs, the equilibrium outcome that maximizes EV sales involves not imposing tariffs. This dilemma, again, highlights the strategic trade-off for the EU between strengthening its EV industry and increasing EV adoption.

4.4 Impact of tariff decisions

While game theory helped identify which tariff strategies may benefit each region, it did not capture the magnitude or broader impact of these decisions. Moreover, beyond the binary choice of whether to impose tariffs, explored through game theory, economic blocs must also decide which industries to target and what tariff levels to apply. These decisions have varying impacts across regions and key metrics.

In this section, we address the second research question by identifying and analysing cross-scenario trends to understand the implications of different tariff policy decisions. Specifically, we focus on the following five decisions:

1. China deciding to not retaliate
2. EU deciding not to impose tariffs
3. US deciding not to impose tariffs
4. Expanding tariffs to other EV supply chain related industries
5. Increasing tariff levels

The 24 counterfactual scenarios are compared in pairs that differ by only one policy decision, allowing us to isolate the impact of each individual choice. Since multiple such pairs exist for each decision, we highlight one representative pair per decision in this section and summarize the common insights observed across all corresponding pairs. The complete results for all scenarios are provided in the Appendix B for reference.

To evaluate each policy decision, we analyse scenarios that are adjacent to the main case, a 20% tariff imposed by the US and EU with Chinese retaliation, shown at the centre of Figure 1 in the box with bolded lines. In each comparison, only one policy dimension is altered at a time. Figure 1 illustrates the structure of these scenario comparisons.

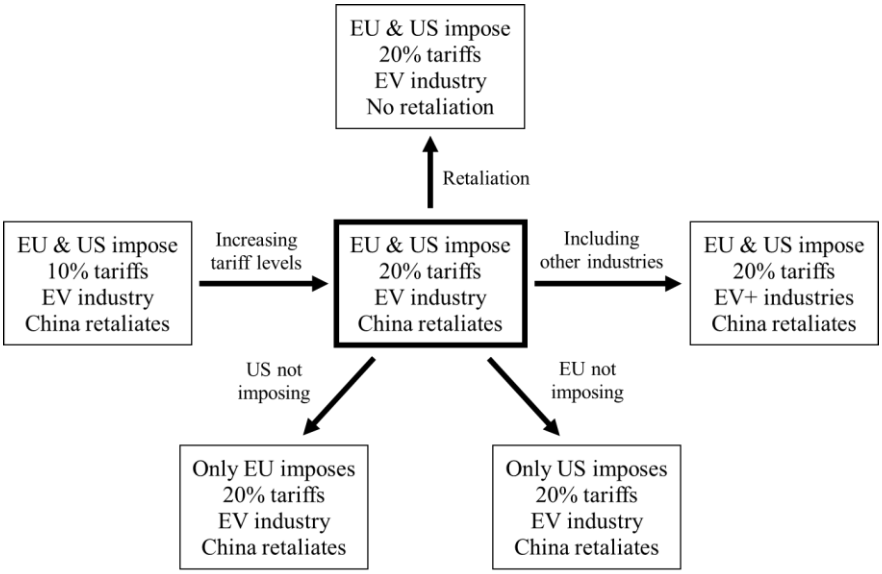

Fig. 1. Diagram illustrating the comparison between scenarios. Scenarios connected by arrows are directly compared, with the specific policy decision being evaluated indicated alongside each arrow. The main scenario, with which other scenarios are compared, is marked with a thick border. "EV+" refers to the EV industry along with the supply chain related industries.

4.4.1. China deciding to not retaliate.

To analyse the impact of China's decision to not retaliate, the main scenario is compared with the scenario where EU and US impose tariffs on Chinese EV imports, but China does not retaliate. The effects on the key metrics of baseline are presented in Table 11.

Table 11. Impact on key baseline metrics (in percentage terms) when the EU and US impose additional 20% tariffs on Chinese EV imports and China does not retaliate. Source: Author's analysis, model results.

Metric	Global	EU	US	China
EV sales	-1.04	-2.5	-0.3	-0.002
EV VA	+0.11	+2.31	+0.61	-1.33
Total VA ($\times 10^{-4}$)	0	+35.5	+8.1	-50.3
Total emissions ($\times 10^{-4}$)	-18.1	+3.2	+2.5	-33.7

Note: Values in green and red indicate increases and decreases, respectively, relative to the main scenario.

Compared to the main scenario, the global EV sales decline further. At regional level, removing Chinese retaliation amplifies the positive effects for the EU and US while deepening the losses for China. In the C&P framework, tariffs raise bilateral trade costs, prompting trade diversion toward lower-cost suppliers. Without retaliation, EU and US exporters retain tariff-free access to the large Chinese market, allowing them to expand sales there while also benefiting from reduced competition from Chinese EVs in their own markets. This dual advantage explains the larger increase in the EU's EV industry VA (2.3%) and the corresponding decline in China's VA (over 1%). In contrast, Chinese EV producers face higher costs in both major export markets while receiving no offsetting gains from higher tariffs on EU and US imports, leading to reduced domestic demand for Chinese EVs and a reversal from the small sales increase seen in the main scenario to a decline. The same trade diversion mechanism explains why the patterns in total VA and emissions, though still small in absolute terms, become slightly more pronounced without retaliation.

4.4.2. EU deciding not to impose tariffs.

To analyse the impact of EU deciding not to increase tariffs, the main scenario is compared with the scenario where US increases tariffs on Chinese EV and China retaliates. The effects on the key metrics of baseline are presented in Table 12.

Table 12. Impact on key baseline metrics (in percentage terms) when the US imposes additional 20% tariffs on Chinese EV imports and China retaliates. Source: Author's analysis, model results.

Metric	Global	EU	US	China
EV sales	-0.77	-1.16	-0.26	+0.01
EV VA	+0.01	+0.04	+0.41	-0.13
Total VA ($\times 10^{-4}$)	0	+0.4	+3.3	-5.3
Total emissions ($\times 10^{-4}$)	-1.9	-0.4	+1.5	-3.6

Note: Values in green and red indicate increases and decreases, respectively, relative to the corresponding results in main scenario.

A comparison with the main scenario shows that, when only the US imposes tariffs on Chinese EVs (with China retaliating), the magnitude of all changes is reduced: negative impacts become less negative, and positive impacts decrease. This outcome follows directly from the C&P model's trade diversion mechanism, which is grounded in Ricardian trade theory. In the main scenario, tariffs in both the EU and US raise bilateral trade costs with China, leading to a sharper reallocation of sourcing away from Chinese suppliers and toward domestic and third-country producers in both markets. This amplifies the effects on trade flows, prices, and ultimately EV industry value added in all regions.

When the EU refrains from imposing tariffs, this diversion is weaker because EU–China trade costs remain unchanged. As a result, Chinese EV exports to the EU remain relatively stable, reducing the overall contraction in China's exports and softening the negative impact on its EV industry. For the US, the absence of EU tariffs means its EVs do not gain as much market share in the EU, limiting the positive output effect observed in the main scenario. In the C&P framework, this occurs because the relative price advantage of US EVs in the EU market does not improve when only the US applies tariffs to Chinese imports.

The differences in trade diversion also explain the EV sales patterns. In the EU and US, EV sales still decline, but by less than in the main scenario, as consumers continue to have access to lower-cost Chinese imports in the EU market and price effects are less pronounced. In China, EV sales increased by 0.3% in the main scenario due to redirection of exports toward the domestic market, but with fewer export losses to the EU in this case, there is less domestic redirection, and the increase is limited to just 0.01%.

From the perspective of the US EV industry, it is advantageous if the EU also participates in imposing tariffs on China. Conversely, for the Chinese EV industry, outcomes are more favourable when the EU refrains from imposing tariffs. However, the opposite holds true when the objective is to enhance EV adoption, further highlighting the trade-off.

4.4.3. US deciding not to impose tariffs.

To analyse the impact of US not imposing additional tariffs, the main scenario is compared with the scenario where EU imposes additional tariffs on Chinese EV and China retaliates. The effects on the key metrics of baseline are presented in in Table 13.

Table 13. Impact on key baseline metrics (in percentage terms) when the EU imposes additional 20% tariffs on Chinese EV imports and China retaliates. Source: Author's analysis, model results.

Metric	Global	EU	US	China
EV sales	-0.84	-2.5	-0.04	+0.3
EV VA	-0.01	+0.81	+0.05	-0.65
Total VA ($\times 10^{-4}$)	0	+17.7	+2.6	-25.7
Total emissions ($\times 10^{-4}$)	-8.65	+3.53	+1.2	-16.4

Note: Values in green and red indicate increases and decreases, respectively, relative to the corresponding results in main scenario.

When only the EU imposes tariffs on Chinese EVs (with China retaliating), the magnitude of changes in key indicators is generally smaller than in the main scenario where both the EU and US impose tariffs. This is consistent with the trade diversion mechanism in the C&P model, which reallocates sourcing toward lower-cost suppliers when bilateral trade costs rise. In the absence of US tariffs, bilateral trade costs between the US and China remain unchanged, so there is no trade diversion in the US market. As a result, the positive value-added effects for the US EV industry observed in the main scenario disappear, and the overall impact on China's exports is smaller.

For the EU, the effects are almost identical to those in the main scenario because the EU–China trade, being greater than the US-China trade volume, is the main driver of changes in China's EV exports. The smaller negative effect on China in this scenario arises because reduced exports to the EU are only partially offset by gains elsewhere, and the US market remains open to Chinese EVs. Interestingly, emissions of EU increase even though VA de-creased. This indicates a shift towards more emission intensive industries as compared to the main scenario.

The comparison between the "EU-only" and "US-only" tariff scenarios highlight the asymmetric structure of trade in the baseline. Since EU–China trade volumes are far greater than US–China volumes (Tables 3 and 4), most of the impact on China in the main scenario is attributable to EU tariffs, with US tariffs contributing only marginally to the overall changes.

4.4.4. Expanding tariffs to other EV supply chain related industries.

In this section, we analyse the results of the scenario in which tariffs are imposed on EV supply chain-related industries, specifically sectors C24, C25, C27, C29, and the EV industry. Before delving into the analysis of each scenario, it is useful to first examine the EV industry's dependence on inputs from these sectors (as shown in Table 14), as well as the sourcing patterns of these inputs across regions (Table 15). Understanding these interdependencies provides important context for interpreting the results.

Table 14 indicates that sectors C27 and C29 are key input providers for the EV industry. Tariffs imposed on these inputs are expected to impact the domestic EV industries negatively. Table 15 further shows that the EV industries in both the EU and the US rely significantly on China for inputs from sector C27. In contrast, China's EV industry sources over 90% of its intermediate inputs domestically. Thus, the negative impact on EV industry in EU and US is expected to be more than the impact on Chinese EV industry.

Table 14. Share of inputs (in percentage terms) from EV supply chain related industries in the EV industries of the 3 regions in baseline. Source: Author's analysis based on FIGARO database (2022).

Industry	EU	US	China
Basic metals (C24)	3	5	7
Fabricated metal products (C25)	4	8	3
Electrical equipment, including batteries (C27)	19	19	21
Motor vehicles (C29)	17	17	20

Table 15. Sourcing pattern (in percentage terms) of inputs from EV supply chain related industries for the EV industries of the 3 regions in baseline. Source: Author's analysis based on FIGARO database (2022).

Region	EU				US				China			
Industry / Region	C24	C25	C27	C29	C24	C25	C27	C29	C24	C25	C27	C29
EU	89	90	61	85	3	2	5	4	0	1	2	4
US	1	0	1	1	79	90	57	63	0	0	0	1
China	1	4	28	2	1	3	15	2	93	97	92	91
RoW	9	6	10	13	17	5	23	31	6	2	6	4
Total	100	100	100	100	100	100	100	100	100	100	100	100

To analyse the impact of expanding tariffs to other industries, the main scenario is compared with the scenario where EU and US imposes additional tariffs on Chinese EV supply chain related industries and China retaliates. The effects on the key metrics of baseline are presented in Table 16.

Table 16. Impact on key baseline metrics (in percentage terms) when the EU and US impose additional 20% tariffs on Chinese EV supply chain related industries and China retaliates. Source: Author's analysis, model results.

Metric	Global	EU	US	China
EV sales	-1.2	-2.9	-0.68	-0.05
EV VA	-0.03	+0.82	-0.16	-0.96
Total VA	0	-0.01	+0.08	-0.21
Total emissions	-0.12	-0.06	+0.07	-0.35

Note: Values in green and red indicate increases and decreases, respectively, relative to the main scenario.

Overall economy: As the scope of tariff increases is expanded to include upstream industries beyond EVs, such as metals, batteries, and electronics, their economy-wide impact becomes significantly larger. Both VA and territorial GHG emissions change by at least two orders of magnitude compared to the EV-only scenario. This is because these basic manufacturing sectors serve as key suppliers of intermediate goods across multiple industries. Tariffs on Chinese imports of intermediate goods made these products more expensive in the EU and US, benefitting their domestic upstream industries. In these regions, value added in each targeted sectors increased by up to 10 billion EUR. In contrast, value added in the corresponding Chinese industries declined by as much as 18 billion EUR, primarily due to reduced exports and weakened domestic demand from its own EV industry. As a result, the effects of the tariffs ripple through the wider economy rather than being confined to the EV sector. This broader disruption leads to a modest decline in global territorial emissions of approximately 0.12%, which corresponds to a reduction of over 50 Mt CO_2-eq.

EV industry: When tariffs extend to upstream sectors, the costs of key inputs rise for domestic EV producers. As a result, the EV industry's output in all three major economies declines relative to the EV-only tariff scenario. The impact is relatively modest for the EU and China due to their high reliance on domestic supply chains, over 85% of most intermediate inputs are sourced domestically.

In contrast, the US EV industry experiences a more pronounced decline due to its greater reliance on imported intermediate inputs, not only from China but also from other countries. Although tariffs were not directly imposed on these third countries, the cascading effects of disrupted global supply chains, caused by reduced Chinese exports and shifting trade flows, negatively impacted their industrial output. As these upstream industries in third countries contracted, the availability and affordability of key inputs for the US EV industry declined. This indirect exposure amplified the adverse effects on US production

EV sales: Impact on EV sales is similar to the main scenario, except that the EV sales in China also decreased, though the decline was limited to just 0.05%. This is because their domestic EV industry, which satisfies over 99% of its EV demand, suffered a greater reduction in output.

Globally, EV adoption falls by approximately 1.2%, as shown in Table 17. When excluding China, the reduction is even more pronounced at around 2.8%. This drop in EV sales translates into an additional 2.5 Mt CO_2-eq. in lifetime emissions from increased use of ICE vehicles, with nearly half of this increase originating from reduced EV sales in the EU.

Table 17. Change in EV sales in scenarios where EU and US impose 20% tariffs and China retaliates. Source: Author's analysis, model results.

Region	Change in EV sales (%)
EU and US	-2.0
World (except China)	-2.8
World	-1.2

4.4.5. Increasing tariff levels.

The results of the 10% tariff scenarios, with and without retaliation, are identical since China already imposes nearly 15% tariffs on EV imports in the baseline. When comparing the 10% tariff scenarios with their corresponding 20% tariff scenarios, the direction of effects remains consistent, but the magnitude of impact is, as expected, lower. Specifically, when both the EU and US impose tariffs, the effects in the 20% scenario are approximately 2–4 times greater. This multiple rises to 4–5 times when only the US imposes tariffs.

When tariffs are expanded to EV supply chain industries, the direction of effects remains consistent across both the 10% and 20% tariff scenarios, as expected. However, the magnitude of the impacts in the 10% scenarios is up to three times lower compared to the corresponding 20% scenarios.

5 Discussion

5.1 Scientific Contribution

This study advances the literature by providing the first integrated analysis of how tariffs on EVs and their critical inputs, such as batteries, rare earth materials, and electronics, affect both climate change and economic outcomes across the three major EV markets: the EU, US, and China. Whereas prior research has largely focused either on domestic EV policies or on the economic implications of broader trade restrictions, the climate change impact of EV-related tariffs, particularly their impact on adoption rates, remain underexplored. By quantifying these outcomes, this thesis addresses a critical gap in the literature and demonstrates how trade policy can simultaneously influence industrial competitiveness, EV adoption, and associated emissions. In doing so, it provides a more comprehensive understanding of the intersections between trade, climate policy, and technological transitions.

5.2 Interpretation of Results and Implications

This study examined two related questions: what are the climate change and economic consequences when the EU and US impose tariffs on Chinese EV exports and China retaliates, and how do those consequences change when we vary the tariff level, the industries targeted, and the economic blocs imposing tariffs? The results of scenarios highlight a consistent conclusion: tariffs reallocate production and trade in ways that give modest support to domestic EV industry value added but simultaneously slow the adoption of EVs and associated climate change benefits. Under the main scenario, EU and US imposing 20% tariffs and China retaliating, global EV adoption drops by roughly 0.87% (about 92.9k vehicles), with the EU suffering the largest regional decline of about 2.5%. The global drop in EV sales translates to an additional 1.85 Mt CO_2-eq of additional lifetime emissions due to slower transition from ICE vehicles to EVs.

The results can be explained through the assumptions of the CGE model and the way the economy is structured within the model. Higher tariffs leading to higher import costs raise final prices for consumers. Since households and producers source from the lowest cost suppliers, according to the Ricardian framework, this triggers trade diversion toward domestic and third-country suppliers while also reducing aggregate demand for EVs where import dependency is high. Thus, protection for domestic producers is achieved, but not without slowing the EV transition that is essential to achieving climate targets.

The game-theoretic analysis helps explain why such tariff policies are politically persistent despite their climate drawbacks. Game-theoretic payoffs indicate that the United States and China have clear incentives to impose tariffs, while the EU faces a dilemma: imposing tariffs tends to increase EU value added but reduces EU EV sales and thus raises emissions. This misalignment of regional industrial incentives and climate objectives means that individually rational choices, aimed at strengthening domestic industry, can lead to a collectively worse environmental outcome. This highlights the value of international coordination: by reducing incentives for tit-for-tat escalation, cooperative approaches can help avoid the mutually damaging outcomes that competitive protectionism produces.

Section 4.4 shows that the distribution and magnitude of effects depend strongly on policy design. Retaliation amplifies distributional shifts and deepens losses for targeted exporters. C&P framework enables the analysis of economy-wide impact of expanding tariffs beyond final vehicles to upstream inputs, batteries, electrical equipment and fabricated metals. It intensifies the negative effects by raising the costs across entire value chains. Global EV adoption falls by up to 1.2% in these scenarios and the associated lifetime emissions rise to roughly 2.5 Mt CO_2-eq.

It is also important to note that even within a region, various stakeholders are affected differently. Producers in the EU and US can expect modest, short-term gains in value added as some demand shifts in their favour. Consumers, however, face higher prices and a slowed transition to low-emission mobility. China's exporters suffer substantial market-share losses. China's EV market share in EU and US declined by 70% and that outside its borders declined by 18%, posing a significant concern for its domestic EV industry. Importantly, targeting upstream inputs can backfire by weakening downstream competitiveness and reducing domestic value added in related sectors, a reminder that narrowly targeted industrial protection can ripple through a complex supply chain and produce unintended negative effects.

Taken together, the evidence suggests that tariffs are an inefficient instrument when policymakers try to pursue both industrial resilience and rapid decarbonisation simultaneously. Even though tariffs might strengthen domestic EV industries, the benefit is quite small and is associated with a considerable negative environmental impact. Instead, a set of domestic policies and strategies should be considered to strike a better balance.

In answering the thesis' main question, therefore, the analysis demonstrates that increased tariffs on EVs and EV supply chains do reallocate industrial gains but slow EV uptake and increase lifetime vehicle emissions. The size and distribution of those effects depend on retaliation, industrial scope, and tariff level. To balance both climate targets and industrial competitiveness, the preferred path is to combine domestic industrial policy with measures that lower consumer prices or increase the non-price competitiveness of domestic supply, rather than relying primarily on import protection that trades immediate limited industrial advantages for delayed climate progress.

Relevance for Knowledge Users.

This study provides policymakers, trade negotiators, and other stakeholders with insights into the direction and magnitude of key economic and climate change impacts associated with tariffs on the EV industry and its supply chains. By quantitatively assessing the effects of diverse trade policy scenarios grounded in current geopolitical dynamics, the analysis helps decision-makers anticipate not only the implications of their own policy choices but also the likely responses of other regions.

In addition to informing tariff strategies, the study highlights critical trade-offs, including unintended environmental consequences that are often overlooked in trade policy discussions. These insights offer a valuable foundation for more holistic decision-making that balances industrial, economic, and climate objectives. The results provide a basis for further detailed analysis and emphasize on the importance of integrating climate considerations into trade policy to support global decarbonisation efforts.

6 Limitations

Disaggregating a sector in a global economic model presents significant challenges, primarily due to limited data availability and the inherent inaccuracies associated with such processes. Previous studies have addressed this challenge through various methods. For example, research using the GTAP database has employed tools like SplitCom in combination with trade data from UN COMTRADE and supplementary production information

(Coffin et al., 2024). Other studies, particularly those focusing on a single region, have used approaches such as Joshi's Model 3 along with Life Cycle Inventory (LCI) data to achieve sectoral disaggregation (Guo et al., 2021 and Guo et al., 2022). Some researchers have also assumed that EVs and non-EVs share the same production structure, with adjustments made to key inputs such as electric equipment to account for battery components (Jiang et al., 2022 and Shin et al., 2017).

However, since this study did not utilise the GTAP database, the SplitCom approach was not applicable. Similarly, applying the LCI-based disaggregation method was challenging given the multi-regional scope of this study, as obtaining regional LCIs and accurately converting quantities to prices is highly complex, especially considering regional price variations in raw materials and components. Consequently, a simplified disaggregation approach with lower data requirements was adopted, which may have introduced some degree of inaccuracy in the results.

Several other assumptions and limitations should be acknowledged. Battery prices used in the disaggregation process were assumed to be uniform across all regions, even though in reality, these prices may vary. Additionally, due to a lack of data, the battery sourcing patterns for major battery-producing countries were approximated using the sourcing patterns of C27 industry products in the original C29 industry, which may not perfectly reflect actual trade dynamics. The substitution elasticity of the disaggregated EV industry was also assumed to be the same as that of the original C29 industry.

To address data inconsistencies in the IO tables, particularly large negative values in the P5M category of final demand (changes in inventories and acquisition less disposals of valuables) that caused convergence issues in the C&P model, the RAS balancing method was applied. While this correction did not significantly alter the overall economic structure, a more technically rigorous approach could have improved accuracy. Furthermore, UN COMTRADE data (UN Comtrade, n.d.) on trade values and quantities was used to estimate EV prices for each exporter-importer pair (as explained in the Section 3.3), which then facilitated the conversion of trade values into EV sales volumes at the regional level. However, international trade data is known to carry inherent inconsistencies, such as mismatches between importer and exporter records. Despite filtering out unreliable unit values, it is possible that some inaccuracies remained in the dataset.

The study employed the C&P CGE model, which is based on the assumption of constant value shares while volume shares can vary. This assumption is generally valid for aggregated industries, where production can shift between multiple products within the sector. However, after disaggregating the EV industry, there is a possibility that changes in prices could lead to unrealistic production structures in physical terms. Nevertheless, in this study, price changes were consistently below 5%, which supports the continued validity of the constant value share assumption. In addition to the C&P model-specific limitations, CGE models are, by design, simplified representations of the real-world economy. They rely on assumptions to make the analysis feasible, which means the results should be interpreted with an acknowledgement of these inherent simplifications.

Moreover, the EV industry is evolving at an exceptionally rapid pace. Although this study relied on the latest available IO tables from 2022, both the structure of the EV industry and associated trade patterns may have experienced significant changes in the last three years. This temporal gap introduces additional uncertainty regarding the applicability of the results.

Overall, while the modelling approach and assumptions were appropriate given the scope and data constraints, these limitations should be considered when interpreting the results.

7 Conclusions

This study examined the economic and climate change impacts of increased tariffs on EVs and their associated supply chains in the context of escalating geopolitical tensions. The main objective was to assess how such trade measures affect EV adoption, associated emissions, and industrial value added across the EU, US, and China. Using a Caliendo and Parro CGE model, the research evaluated various scenarios to address the main research question: what are the climate change and economic impacts of increased tariffs on EVs and associated supply chain industries, and how do these affect EV adoption?

The results indicate that when tariffs are imposed solely on the EV manufacturing industry, the EU and US see a moderate increase in the value added of their domestic EV sectors, but this comes at the cost of reduced EV adoption, particularly in the EU, where sales decline by about 2.5%. Globally, EV sales outside China also decline by 2.4%. The drop in global adoption results in an estimated 1.85 Mt CO_2-equivalent of additional lifetime emissions from slower transition to EVs from ICE vehicles, with more than half of these emissions linked to the decline in EV sales in the EU. While China's EV industry is negatively affected, EV adoption within China increases marginally in some cases, reflecting the strength of its domestic production base.

Due to the higher trade volume between the EU and China, tariffs imposed by the EU have a significantly greater negative impact on China compared to those imposed by the US. Trade diversion away from China has led to a decline in market share of Chinese EVs in EU and US by over 70% and 18% globally outside China, posing a major threat to China's dominance in global EV industry.

Tariff imposition emerges as a dominant strategy for both China and the US. However, the EU faces a policy dilemma, while tariffs support its EV industry, they lead to a reduction in EV adoption. The impact of tariff levels is non-linear, with effects intensifying by a factor of 2 to 4 when tariff rates increase from 10% to 20%. The macroeconomic impact remains relatively modest due to the EV industry's small share in overall economic activity.

Expanding tariffs to include upstream supply chain industries such as electrical equipment, fabricated metal products, and batteries leads to more pronounced negative effects and disrupt multiple sectors beyond the EV industry. While this strategy may reduce dependence on Chinese inputs, it also causes a greater decline in EV sales across all regions. In the EU sales fall by almost 3%, with similar declines observed outside China, including in regions not directly involved in the tariff dispute. This is a particularly concerning trend given the urgency of decarbonizing the road transport sector. Although the EU's EV industry still benefits, the gains are smaller than when tariffs target only the EV sector. In contrast, the EV industries in both the US and China perform worse compared to a no-tariff scenario. At the economy-wide level, the impacts remain modest, but sector-specific disruptions are more significant, particularly in key upstream industries. In terms of strategic responses, tariff imposition continues to be a dominant choice for China, but it is no longer the preferred option for the US. The EU, meanwhile, faces the same policy dilemma: both imposing and refraining from tariffs involve trade-offs between industrial competitiveness and environmental goals.

The CGE methodology, widely used for studies of this kind, was well-suited to assess the interconnected economic and climate change impacts explored here. However, disaggregating the EV sector required several simplifying assumptions. Given the rapid evolution of the EV industry, relying on 2022 IO data limits the precision of the findings but still provides valuable insights into the direction of emerging trends. Additionally, while the model effectively captures structural changes in trade and production, it does not account for dynamic real-world factors such as shifts in consumer behaviour or accelerated technological innovation, which could further influence outcomes.

Future research would benefit from a more accurate disaggregation of the EV industry and using dynamic modelling approaches using latest data. Exploring alternative policy instruments that strengthen domestic supply chain could offer more holistic solutions that support both industrial resilience and climate action. In sum, this study underscores the importance of aligning trade strategies with environmental objectives. As governments navigate the path to decarbonisation, policy coherence across industrial, trade, and climate domains will be essential to ensure that progress in one area does not come at the cost of setbacks in another.

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Appendix A: Methodology

Disaggregation steps:

1. Estimation of intermediate inputs: The estimation of production structure of EV industry follows the approach outlined by Leurent and Windisch (2015). Battery prices have reduced significantly due to technical advancements from 2015 to 2022 (BloombergNEF, 2022). In this manner, production structure of EV industry of each region was derived. Some countries, which had an unusual C29 production structure were assumed to not produce EVs. These countries are Cyprus, Denmark, Greece, Croatia, Ireland, Luxembourg, Latvia, Malta, Norway, and Saudi Arabia.
   Battery sourcing pattern for EV industries in non-major battery producing regions was based on BACI trade data. Whereas, for major battery producing countries, it was assumed to be same as the sourcing pattern of C27 industry products by the original C29 industry.
2. Estimation of final goods output: EV sales and trade data was based on the study by Ndubuisi and Stöllinger (2024). The sourced the trade data from UN Comtrade, and the sales data from the International Energy Organization (IEA) and from the statistical portal Statista. The data was converted from USD to EUR using conversion rate (1 EUR = 1.053 USD) from EUROSTAT (European Commission, Eurostat, n.d.)

Listed below are the inputs required by the C&P model, along with the data used to derive them:
1. IO coefficients: disaggregated IO table
2. Share of value added in gross output: disaggregated IO table
3. Gross output: disaggregated IO table
4. Baseline tariffs: WITS tariff data
5. Counterfactual tariffs: scenario tariffs
6. Bilateral trade flows: disaggregated IO table and WITS tariff data
7. Elasticities were used as it is

Appendix B: Complete results

Table 18. Relative change in key metrics (in percentage) as compared to the baseline in each region in each scenario analysed in this study

Scenario	Region	EV sales	EV VA	EV emissions	Total VA	Total emissions
EU&US-China_EV_10pct	EU	-2.10%	1.49%	1.59%	0.00240%	0.00021%
	US	-0.22%	0.42%	0.42%	0.00056%	0.00018%
	CN	0.00%	-0.89%	-0.89%	-0.00338%	-0.00227%
EU&US-China_EV_10pct_retaliation	EU	-2.10%	0.48%	0.66%	0.00119%	0.00021%
	US	-0.22%	0.32%	0.32%	0.00040%	0.00018%
	CN	0.21%	-0.52%	-0.52%	-0.00204%	-0.00133%
EU&US-China_EV_20pct	EU	-2.49%	2.31%	2.46%	0.00355%	0.00032%
	US	-0.30%	0.61%	0.61%	0.00081%	0.00025%
	CN	0.00%	-1.33%	-1.33%	-0.00503%	-0.00337%
EU&US-China_EV_20pct_retaliation	EU	-2.49%	0.85%	1.13%	0.00181%	0.00031%
	US	-0.30%	0.47%	0.47%	0.00058%	0.00026%
	CN	0.31%	-0.78%	-0.78%	-0.00310%	-0.00199%
EU&US-China_EV_supply_chain_10pct	EU	-2.28%	1.07%	1.17%	0.08352%	0.07254%
	US	-0.45%	0.01%	0.01%	0.07879%	0.06120%
	CN	-0.06%	-0.96%	-0.96%	-0.23964%	-0.38727%
EU&US-China_EV_supply_chain_10pct_retaliation	EU	-2.38%	0.44%	0.58%	-0.00515%	-0.04315%
	US	-0.48%	-0.12%	-0.12%	0.06079%	0.04602%
	CN	-0.03%	-0.63%	-0.63%	-0.14702%	-0.24887%
	EU	-2.77%	1.75%	1.90%	0.11669%	0.11291%

EU&US-China_EV_supply_chain_20pct	US	-0.64%	0.04%	0.04%	0.11053%	0.09185%
	CN	-0.09%	-1.44%	-1.44%	-0.33948%	-0.55754%
EU&US-China_EV_supply_chain_20pct_retaliation	EU	-2.89%	0.82%	1.03%	-0.00988%	-0.05803%
	US	-0.68%	-0.16%	-0.16%	0.08433%	0.06898%
	CN	-0.05%	-0.96%	-0.96%	-0.20647%	-0.35221%
EU-China_EV_10pct	EU	-2.10%	1.46%	1.56%	0.00238%	0.00026%
	US	-0.03%	0.04%	0.04%	0.00025%	0.00004%
	CN	0.00%	-0.77%	-0.77%	-0.00291%	-0.00195%
EU-China_EV_10pct_retaliation	EU	-2.10%	0.45%	0.64%	0.00117%	0.00024%
	US	-0.03%	0.04%	0.04%	0.00017%	0.00008%
	CN	0.20%	-0.42%	-0.42%	-0.00166%	-0.00108%
EU-China_EV_20pct	EU	-2.48%	2.27%	2.42%	0.00352%	0.00038%
	US	-0.04%	0.05%	0.05%	0.00038%	0.00006%
	CN	0.00%	-1.16%	-1.16%	-0.00436%	-0.00291%
EU-China_EV_20pct_retaliation	EU	-2.49%	0.81%	1.09%	0.00177%	0.00035%
	US	-0.04%	0.05%	0.05%	0.00026%	0.00011%
	CN	0.30%	-0.65%	-0.65%	-0.00257%	-0.00164%
EU-China_EV_supply_chain_10pct	EU	-2.28%	0.89%	1.00%	0.07464%	0.07115%
	US	-0.01%	0.30%	0.30%	0.01412%	0.00718%
	CN	-0.03%	-0.76%	-0.76%	-0.11579%	-0.19681%
EU-China_EV_supply_chain_10pct_retaliation	EU	-2.38%	0.23%	0.38%	-0.01795%	-0.04933%
	US	-0.04%	0.24%	0.24%	0.01474%	0.01214%
	CN	0.03%	-0.46%	-0.46%	-0.04215%	-0.08349%
EU-China_EV_supply_chain_20pct	EU	-2.77%	1.49%	1.66%	0.10301%	0.10901%
	US	-0.01%	0.43%	0.43%	0.02023%	0.01087%
	CN	-0.04%	-1.16%	-1.16%	-0.16293%	-0.28204%
EU-China_EV_supply_chain_20pct_retaliation	EU	-2.89%	0.52%	0.75%	-0.02929%	-0.06964%
	US	-0.05%	0.34%	0.34%	0.02125%	0.01802%
	CN	0.04%	-0.72%	-0.72%	-0.05803%	-0.11459%
US-China_EV_10pct	EU	-1.16%	0.03%	0.03%	0.00002%	-0.00004%
	US	-0.19%	0.38%	0.38%	0.00031%	0.00014%
	CN	0.00%	-0.12%	-0.12%	-0.00048%	-0.00033%
US-China_EV_10pct_retaliation	EU	-1.16%	0.03%	0.03%	0.00003%	-0.00003%
	US	-0.19%	0.28%	0.28%	0.00023%	0.00011%
	CN	0.01%	-0.09%	-0.09%	-0.00038%	-0.00026%
US-China_EV_20pct	EU	-1.16%	0.04%	0.04%	0.00003%	-0.00006%
	US	-0.26%	0.56%	0.56%	0.00044%	0.00020%
	CN	0.00%	-0.17%	-0.17%	-0.00068%	-0.00047%
US-China_EV_20pct_retaliation	EU	-1.16%	0.04%	0.04%	0.00004%	-0.00004%
	US	-0.26%	0.41%	0.41%	0.00033%	0.00015%
	CN	0.01%	-0.13%	-0.13%	-0.00053%	-0.00036%
US-China_EV_supply_chain_10pct	EU	-1.14%	0.18%	0.17%	0.00830%	0.00103%
	US	-0.44%	-0.29%	-0.29%	0.06395%	0.05346%
	CN	-0.03%	-0.19%	-0.19%	-0.12181%	-0.18713%
	EU	-1.15%	0.21%	0.19%	0.01180%	0.00450%
	US	-0.45%	-0.37%	-0.37%	0.04651%	0.03406%

US-China_EV_supply_chain_10pct_retaliation	CN	-0.06%	-0.16%	-0.16%	-0.10438%	-0.16342%
US-China_EV_supply_chain_20pct	EU	-1.13%	0.26%	0.23%	0.01247%	0.00306%
	US	-0.62%	-0.39%	-0.39%	0.08884%	0.07978%
	CN	-0.05%	-0.27%	-0.27%	-0.17230%	-0.26848%
US-China_EV_supply_chain_20pct_retaliation	EU	-1.15%	0.29%	0.27%	0.01749%	0.00799%
	US	-0.63%	-0.50%	-0.50%	0.06412%	0.05138%
	CN	-0.09%	-0.23%	-0.23%	-0.14768%	-0.23370%

Note: Scenario names follow the format <Imposing region(s)>-<Target region>_<Scope>_<Tariff rate>_<Retaliation>. For example, EU-China_EV_10pct denotes a 10% EU tariff on Chinese EVs without retaliation from China.