Carbon protectionism?

Stock market reactions to the Carbon Border Adjustment Mechanism within the European Union

Keywords: Event study, Cumulative Abnormal Return, EU CBAM, ETS, Sustainable finance

Abstract: This study examines the market reactions and valuation implications of the Carbon Border Adjustment Mechanism (CBAM) adopted by the European Union (EU). The CBAM is the world's first carbon border import tax aimed at addressing carbon leakage and promoting a transition to a low-carbon economy. Using an event study methodology and regression analysis, we analyze the response of stock prices of EU-based firms in affected industries to CBAM legislation announcements. Our findings indicate that the market reactions to CBAM announcements were limited, with only a few events showing statistical significance. Regression analysis reveals a uniform effect across affected industries' cumulative abnormal returns (CARs), while the relationship between the share of sales in the EU and CAR remains inconclusive. The results suggest that the positive market sentiment towards protectionist trade policies, as anticipated by classical trade theory, may not be fully realized in the context of a carbon emission-targeted import tariff. Assuming the efficient market hypothesis holds (EMH), we provide three possible explanations for these findings; i) the evaluation of the CBAM in conjunction with the EU's commitment to the Emissions Trading System (ETS), ii) investor considerations of political aspects such as trade wars and lobbying activities, and iii) issues related to implementation and accounting complexities related to the policy.

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1. Introduction

On April 18th, 2023, the European Parliament gave its final blessing to adopt the world's first carbon border import tax – the Carbon Border Adjustment Mechanism (CBAM). The introduction of the CBAM stems from the issue of firms relocating their production abroad to avoid carbon costs under the European Union's (EU) Emissions Trading System (ETS), effectively undermining the ETS as a system requiring firms to pay for their CO2 emissions. By imposing an import tariff on goods from the most carbon-intensive industries, Steel and Iron, Electricity, Fertilizers, Aluminum and Cement, that account for approximately 17% of EU CO2 emissions (Benson et al., 2023), the CBAM will create a level playing field by ensuring that foreign producers bear a similar carbon cost as domestic producers, discouraging carbon leakage and promoting the transition to a low-carbon economy.

According to classical trade theory, an import tariff should affect protected industries positively (Krugman, 2023). The introduction of a surcharge on imported goods, all else being equal, is expected to yield positive outcomes for the industry by reducing competition from exporting companies, raising equilibrium prices, and consequently enhancing implicit profits on sales. As such, stock market reactions for companies in affected industries should be positive. Empirical evidence from historical instances in the US, Europe and China supports this prediction (Lenway et al., 2019; Crowley et al., 2019; Huang, 2020). Moreover, few areas within business and economics have received as much attention as the link between sustainability and corporate valuation in recent years. Previous research on the effect of green policies on valuations has provided incoherent results, also because of policies not having a material impact on firms' financial performance historically. Nevertheless, empirical studies have established a link between surpassing firms' permitted emissions allowances and their market valuations (Oestreich and Tsiakas, 2015; Jong et al., 2014).

Yet, there is little research that has focused on the intersection of sustainability and trade policies, such as a carbon emissions-targeted import tariff. One study (Shen et al., 2023) finds compelling evidence indicating a significant and proportionally larger negative abnormal return associated with the implementation of the CBAM for Chinese industrial firms, contingent upon their exposure through exports to the EU market. However, no previous research has been conducted to quantify the effects of CBAM on the valuation of EU companies directly affected by the policy. The objective of this paper is to address this apparent research gap. Obtaining a deeper understanding of the market's perception of the CBAM and its prospective implications on the affected industries is critical to evaluate the policy's viability and effectiveness as a strategic tool towards achieving global carbon reduction objectives. As such, we form three hypotheses to be tested: Firstly, we investigate whether the market efficiently incorporates announcements of decisions increasing the likelihood of an implementation of the CBAM. Secondly, we test whether the market reaction is correlated with the proportion of sales that a firm has within the EU. Lastly, the paper examines whether the market reaction is industry uniform across the five industries affected by the policy.

To address these questions, we study the response of stock prices of affected EU-based firms in relation to 14 pertinent CBAM legislation announcements. We employ an event study methodology built on the market model. We form a 90-trading-day estimation window [-91, -2] to predict expected returns and utilize a 5-day event window [-1, 3] to estimate cumulative abnormal returns (CAR) associated with each material event. We further perform regression analysis, regressing an industry dummy on CAR, indicating whether the firm belongs to one of the directly affected industries by the CBAM. Across the 14 identified events, we find that only four of them exhibited statistical significance, with three showing investor sentiments against the policy, and event-specific regressions revealed that only one event remained significant. Alternative analyses and robustness tests did not yield significant differences. The relationship between sales in the EU and the CAR coefficient was inconclusive, and the policy's effect was more uniform across industries than expected.

We provide three possible explanations for our observed results. Firstly, we argue that advancement in the legislation for the CBAM may not only be perceived by investors as a separate policy, but in conjunction with the EU centering its climate policy around the ETS. The phase-out of free emission allowances under the ETS is associated with a negative impact on the affected firms' financial performance due to increasing carbon costs for treatment firms. Consequently, the progression of the legislative process concerning the CBAM solidifies the EU's commitment to ETS as a pivotal component to combat climate change, hence offsetting the hypothesized positive market reactions tied to protectionist trade policy. Secondly, we posit that the political dimension may induce investors to incorporate the risk of trade wars impeding companies' exports. Also, the occurrence of lobbying activities may diminish the overall effectiveness of the policy. Lastly, we discuss the challenges associated with the implementation process, including accounting complexities and other relevant factors. These intricacies may lead investors to perceive the policy as having limited value or being inconsequential in terms of its impact.

In conclusion, our study does not prove a significant positive abnormal return for companies subjected to the CBAM. While our hypothesis draws upon classical trade theory, we find limited evidence supporting a favorable sentiment towards protectionism, which has been empirically proven in other studies on different markets. These findings highlight the intricate nature of intertwining trade policies within the framework of environmental objectives and requires further research to understand the underlying factors driving the market reactions.

Our thesis is structured as follows: We begin by presenting a comprehensive background on the EU ETS, highlighting the program's initial phases, diminishing its effectiveness in later stages. Additionally, we delve into the CBAM proposal as a tool to address carbon leakage (Section 2). Subsequently, we conduct a thorough literature review to establish the foundation for our research question (Section 3). We then outline our event study methodology (Section 4) and provide descriptive statistics for our extensive sample of listed firms in the EU, along with our treatment group of CBAM companies (Section 5). Thereafter we present our results (Section 6), followed by an evaluation of both the results and our methodology (Section 7). Lastly, we present our conclusion and offer suggestions for further research (Section 8).

2. Background

2.1 The Birth of EU's Emissions Trading System

Initiated in 2005, the EU Emissions Trading System (ETS) is the world's first international emissions trading system for carbon dioxide (CO2). The trading system is a cornerstone of the EU's efforts to address climate change as it puts a price on CO2 emissions. In practice, the EU ETS is a carbon market mechanism that operates on the principle of "cap and trade", setting a cap on the total amount of allowed CO2 emissions from major emitters like power plants, manufacturing facilities, and airlines. This cap is established by issuing allowances, each representing the right to emit one ton of CO2 or its equivalent. Some allowances are auctioned, while others are allocated for free to industries at high risk of relocating production to countries with laxer emission regulations. These allowances can subsequently be traded among participants, fostering a market for emissions permits. If a company emits more than its allotted amount, it must purchase additional allowances from other companies that possess surplus allowances on the market. The gradually decreasing cap on the number of allowances creates their value, generating a financial incentive for companies to reduce their emissions and invest in clean energy and efficiency measures. At the end of each year, firms are obligated to surrender an adequate number of allowances to offset their emissions. Failure to comply results in substantial fines. On the other hand, companies that successfully reduce their emissions can retain any surplus allowances for future use or capitalize on them by selling them to other companies (European Commission I, 2023).

The ETS has faced criticism for its slow pace of emissions reduction and the large number of allowances that have been handed out for free, which has resulted in windfall profits for companies. The ETS system has also been criticized to lead to carbon leakage, whereby domestic CO2 emission reductions are offset by increased emissions in other countries (Misch and Wingender, 2021). Despite these challenges, the ETS remains an important tool in the EU's efforts to address climate change and is widely seen as a model for carbon markets around the world (Apun & Wettengel, 2023).

2.2 EU ETS Phases and Carbon Leakage

The EU ETS has undergone several phases since its inception. Phase 1 (2005-2007) was a three-year pilot aimed to "learn by doing" and prepare for the second phase. The first phase of the ETS was successful in establishing a price for carbon, enabling the free trade of emissions allowances throughout the EU, and establishing the necessary infrastructure for monitoring, reporting and verification of emissions from participating businesses. However, phase 1 caps were set based on estimates due to a lack of reliable emissions data. This resulted in the issuance of more allowances than emissions, leading to an oversupply, and in 2007 the price of allowances fell to zero (phase 1 allowances could not be carried forward for use in phase 2). During phase 2 (2008-2012), key changes included a lower cap on allowances, stricter penalties

for non-compliance, the inclusion of nitrous oxide emissions from nitric acid production, and the addition of the aviation industry. The cap on allowances was reduced based on actual emissions, thanks to the availability of verified data from phase 2. However, the 2008 financial crisis resulted in greater-than-anticipated emissions reductions, causing a surplus of allowances and credits, and putting downward pressure on the carbon price throughout the phase (European Commission II, 2023). The EU ETS underwent significant changes during the third phase (2013-2020), compared to its previous phases. During this phase, the scope of the ETS was expanded to include more sectors and gases. It also introduced a single, EU-wide cap and made auctioning the default method for distributing allowances, with harmonized rules for free allocation. By 2020, emissions under the ETS had decreased by 41% compared to 2005, surpassing the 2020 target of a 21% reduction set for phase 3 (Erbach and Foukalová, 2023). Phase 4 (2021-2030) features a cap that aligns with the goal of reducing EU greenhouse gas (GHG) emissions by 40% compared to 1990 levels. Furthermore, the "Fit for 55" legislative proposal, aimed at reviewing the ETS, aims to make the emissions trading system consistent with the European Climate Law's goal of reducing net emissions by 55% before 2030. This is achieved by reducing the cap, expanding the scope to include more sectors, and enhancing the overall functioning of the ETS. To speed up the reduction of emissions, the total number of emission allowances is decreasing by 2.2% annually from 2021. Additionally, the allocation of free allowances has been extended for another decade, but with revised criteria that prioritize sectors at higher risk of carbon leakage (European Commission III, 2023). In summary, the EU ETS has, from its inception, fallen short of making a substantial impact on carbon-intensive industries, primarily attributed to challenges associated with the excessive allocation of free allowances. However, with the advent of Phase 4, a new era emerges, characterized by heightened costs associated with carbon emissions and a more aggressive phase-out of free allowances.

The issue of carbon leakage refers to the transfer of production to countries with laxer emissions regulations due to the cost of climate policies, resulting in higher global total emissions. Industries at high risk of carbon leakage, such as energy-intensive ones, are given a greater share of free allowances in the EU ETS to maintain their competitiveness. During phase 4 (2021-2030), this policy will be maintained but with stricter criteria and better data (European Commission III, 2023). Carbon leakage is a major concern for policymakers and a crucial issue in international climate policy discussions. First, it reduces the impact of unilateral environmental policies. Second, it threatens domestic economic competitiveness and global market share. If the carbon price increases and domestic goods become more expensive, consumers may switch to foreign products, leading to an increase in emissions abroad. Third, it provides justification for the CBAM. Empirically, studies have shown that the impact of carbon leakage varies between countries, and it can be substantial in some cases, especially in small open economies, which in large constitute the European Union (Misch and Wingender, 2021)

2.3 The EU Green Deal

Proposed by the European Commission in 2019 and adopted by the European Council in 2020, the European Green Deal is a plan to make Europe the first climate-neutral continent by 2050. This political commitment is aimed to be converted into a legal obligation through a binding European Climate Law (European Research and Innovation Network, 2023). The initiative encompasses measures across all sectors and emphasizes the promotion of clean energy, sustainable agriculture, and a circular economy, as well as investments in clean technologies and improvements in energy efficiency to reduce emissions. The Green Deal's ultimate objective is to safeguard the environment and combat climate change while transforming the EU into a modern, resource-efficient, and competitive economy. To date, the European Commission has proposed a set of measures to align the EU's climate, energy, transportation, and taxation policies towards reducing net greenhouse gas emissions by a minimum of 55% by 2030, relative to 1990 levels. More specifically, on July 14, 2021, the European Commission proposed a series of legislative measures to attain climate neutrality in the EU by 2050, with an interim goal of a minimum 55% reduction in net greenhouse gas emissions by 2030. The package revises multiple EU climate laws, including the EU ETS, and outlines the concrete steps the Commission plans to take towards achieving the European Green Deal's EU climate targets (European Commission IV, 2023).

2.4 Combating Carbon Leakage

The EU aims to lead the way in combating climate change with the European Green Deal. This plan outlines a comprehensive strategy to achieve a 55% decrease in carbon emissions by 2030, compared to 1990 levels, and to become a carbon-neutral continent by 2050. The July 2021 package aimed at supporting the EU's climate goals is a crucial element of the strategy to achieve these goals and to fix the position as a global climate leader. The CBAM is one of the key measures included in this package and is aimed to reduce the threat of carbon leakage and reinforce the EU's efforts to reduce emissions, all while ensuring compatibility with World Trade Organization (WTO) regulations (European Commission V, 2023).

Albeit the ETS system has been effective in reducing Co2 emissions, it incentivizes firms to move production abroad, leading to carbon leakage. The CBAM is aimed to progressively address this issue by monetarily incentivizing green investments, in combination with the EU Commission's new proposal to decrease the number of free allowances over time. More specifically, the purpose of CBAM is to equalize the price of carbon between domestic products and imports, ensuring that the EU's climate targets are not compromised by the relocation of production to regions with less stringent climate policies. To ensure stability and legal certainty for businesses and other countries, the CBAM will be introduced gradually, initially only applying to high-risk industries; iron and steel, cement, fertilizers, aluminum, and electricity generation. A reporting system will be in place as of 2023 to facilitate the rollout and dialogue with third countries, and importers will begin to pay a financial adjustment in 2026 (European Commission V, 2023).

In practice, the CBAM will work as a complementary system to the ETS, based on certificates to track and regulate the embedded emissions in imported products. More specifically, EU importers will purchase carbon certificates equal to the cost that would have been paid if the goods had been produced under the EU's carbon pricing rules. Contrarily, non-EU producers can deduct the cost fully if they can prove that they have already paid a price for the carbon used in production in a third country. Thus, the CBAM will incentivize non-EU producers to adopt more environmentally friendly production processes, reducing the risk of carbon leakage. The certificates will reflect the ETS price, based on the weekly average auction price of EU ETS allowances in EUR / ton of CO2 emitted. This is to ensure a level playing field between EU and non-EU businesses by ensuring that importers pay the same carbon price as domestic producers. Once the CBAM regime becomes fully operational in 2026, it will reflect the revised ETS system as free allowances are reduced for covered sectors. Thus, before free allowances are fully phased out in 2035, the CBAM will only apply to the proportion of emissions not benefited by free allowances under the EU ETS. This is to ensure that importers are treated fairly in comparison to EU producers. The national authorities will play a key role in the implementation and supervision of the CBAM system, since they will be responsible for authorizing the registration of declarants, reviewing and verifying their declarations, and selling CBAM certificates to importers (European Commission V, 2023).

The European Commission has proposed a transitional phase for the implementation of the CBAM system. Starting in 2023 and ending in 2025, importers will be required to report the emissions embedded in their goods, but without having to pay a financial charge. This transitional phase will allow for a gradual and predictable transition for EU and non-EU businesses and authorities as the final system is put into place. Once the definitive CBAM system is fully operational in 2026, EU importers will be required to declare the quantity of goods and the number of embedded emissions they import into the EU each year and surrender the corresponding number of CBAM certificates. As mentioned previously, the CBAM will initially be applied to sectors with high carbon emissions and a high risk of carbon leakage and will regulate the direct emissions of greenhouse gases generated during the production process of the covered products. By the end of the transition period, the European Commission will evaluate the effectiveness of the CBAM and consider extending its scope to include more products and services, including indirect emissions such as those from electricity used in production (European Commission V, 2023).

The current form of the CBAM proposal addresses financial charges exclusively on non-European imports. However, the proposal lacks any recommendations to specifically incentivize exports for European businesses in the relevant CBAM sectors. This has led some to argue that the proposal falls short in suggesting a replacement for the free allowances that will be completely phased out by 2035. Critics suggest that the absence of any export rebates may drive producers to shift their carbon-intensive production outside of the EU, undermining the primary aim of the CBAM to reinforce European competitiveness. The EU's rationale for not incorporating export rebates into the CBAM proposal is due to potential violations of the WTO regulations against subsidies. Instead of export rebates, the EU has pledged to investigate

alternative, WTO-compliant methods to address carbon leakage in exports (Tax Foundation, 2023)

2.5 Accounting and Reporting for The EU ETS and Emissions

At its simplest, carbon accounting involves valuing assets, such as granted pollution rights, and liabilities, such as the need to purchase additional rights to cover emissions. Under the EU ETS, carbon trading creates short-term and potentially long-term financial implications for companies. At the end of each year, organizations must match their actual emissions with a sufficient number of allowances and surrender them to the national registry. Any excess allowances can subsequently be traded, and organizations must acquire additional allowances if their actual emissions exceed their allowances. Thus, failing to stay within emissions levels or failing to purchase emissions to cover excess emissions results in a double penalty, and could incur substantial costs for those breaching their allowance inventory.

There are three main approaches for accounting and reporting EU allowances to date: (i) a net liability approach, which recognizes allowances as intangibles but only shows an emission liability when it exceeds the free allocation; (ii) an approach based on IFRIC 3, which recognizes free allocation at fair value and a corresponding gross liability under the EU ETS; and (iii) an inventory-based approach, which values free allocations at zero. However, in a study, prominent accounting issues were detected due to a lack of uniformity in approach, a lack of standardization in reporting, as well as a significant lack of disclosure of ETS accounting in many of the companies' financial reports (Black, 2013).

Moreover, the EU has been at the forefront of advancing sustainability reporting in recent years. In accordance with the European Green Deal, the EU introduced the Non-Financial Reporting Directive (NFRD) in 2014. This EU law mandates large companies to report on their environmental, social, and governance (ESG) performance (European Commission VI, 2023). Furthermore, in 2018, the EU presented an Action Plan on Sustainable Finance, which included several initiatives to enhance the quality and comparability of sustainability reporting, including the development of the unified EU taxonomy, which is a classification system providing a list of environmentally sustainable economic activities. Additionally, the EU's Climate Monitoring Mechanism mandates that all member countries monitor their emissions and follow the EU's internal reporting rules, such as tracking and reporting emissions of seven greenhouse gases (the greenhouse gas inventory) from all sectors of the economy. Currently, there are several frameworks covering requirements and guidelines for sustainability reporting. The most prominent is the GHG Protocol, serving as the accounting platform for almost all corporate greenhouse gas (GHG) reporting initiatives worldwide. Technically, the GHG protocol categorizes an organization's emissions into three distinct scopes. Scope 1 emissions represent direct emissions from the organization's facilities, while Scope 2 emissions denote emissions from the generation of purchased electricity. Lastly, Scope 3 emissions refer to all residual indirect emissions (US Environmental Protection Agency, 2023).

3. Literary Review and Hypotheses Development

This section is divided into three parts. First, theories and empirical research on import tariffs are discussed to understand the potential effect of the introduction of an import tax on carbon emitted outside of the EU. Secondly, previous research on the relationship between stock market returns and green legislation is presented. Thirdly, we discuss previous research on the potential implications of a carbon border and its implication for firm valuation.

3.1 Research on Reactions to Trade Regulations

3.1.1 An Introduction to International Trade Theory

International trade of goods and services is a well-studied research field. With global trade between nations growing significantly during the 20th century, economies have become more intertwined and trade policy is today an essential subject for political decision-makers. The Ricardian view on trade explains that countries benefit from trading goods and services because they can specialize in producing what they are comparatively efficient at manufacturing, while buying goods and services from countries that are comparatively more efficient at producing them. This specialization allows countries to allocate their resources efficiently and maximize their production output, resulting in increased productivity and economic growth. This allows for more optimal utilization of resources which benefits both parties (Krugman et al., 2022).

On the other hand, throughout history, import tariffs have served as a vital source of income for governments, and have functioned as a crucial mechanism for safeguarding domestic industries. In an international connected market, the global price of goods can be lower than the domestic cost of producing them. Implicitly, introducing a tariff on imported goods in such a market will increase the price of international goods, pushing up the equilibrium price. Hence, domestic producers earn a higher margin, all else equal, on their sold goods at the detriment of the consumer that will pay a higher price. Moreover, in Alfred Marshall's view, import tariffs reduce collective wealth as it gives rise to a deadweight loss, arising due to a distortion of incentives for producers and consumers, leading to a suboptimal allocation of resources. Tariffs artificially increase the price of imported goods, shifting demand towards domestic products, resulting in a misallocation of resources. Paul Krugman however argues against the generalizability of Marshall's theory of deadweight loss. Krugman suggests that in certain situations, government intervention in the form of subsidies or tariffs can help domestic firms to achieve economies of scale and compete more effectively against foreign firms in industries with high fixed costs of production, resulting in larger shares of the global market and higher profits. However, Krugman recognizes that his theory of "Strategic trade policy" can only be used in special situations, as one country introducing tariffs severely risks a spiral of retaliatory actions from other nations and a trade war (Krugman et al., 2022). In the scope of this thesis, trade policy is applied in a sustainability context, which is a relatively unexplored area, and represents a prominent research gap.

3.1.2 Empirical Findings on Trade Policy and Firm Valuation

Empirical research on the relationship between financial markets and trade policy is generally coherent with the predictions from the classical theoretical framework put forward by Marshall and Ricardo. Against the background of increased US tariffs on Chinese goods across several industries, Boer et al. (2021) studied the effects of this one-sided trade policy on financial markets. The authors estimate the effect of the change in several national stock market indices surrounding multiple announcements of increasing import tariffs between 2017-2020. The results indicate that 90% of stocks listed on the S&P 500 experience a statistically significant decrease in stock prices following a trade policy shock. Moreover, 44 of 49 studied international indices declined significantly following the announcements. Boehr's findings on the negative financial effects of the US trade policy on Chinese goods are consistent with the measured decline in real income for Americans, which amounted to a staggering 1.4 billion USD per month by the end of 2018 (Amiti et al., 2019). These results highlight the significant impact that trade policies can have on both domestic and international economies.

Other research has also investigated whether protectionist trade policies benefit the domestic industry's competitiveness toward international peers. One study by Hughes et al. (1997) explores the market reaction to the trade accord between the US and Japan in the semiconductor industry. The agreement put a price floor on Japanese semiconductors exports as well as a 20% market share target of American semiconductors in the Japanese market. The study finds that the agreement was followed by positive abnormal stock returns for US semiconductor companies. Similar positive abnormal returns in protected industries have been found in the steel industry. Lenway et al. (1990) formed a portfolio of US steel stocks and observed price movements around policy decisions from 1969 to 1982, either in the direction of protectionism or trade liberalization. Policies aimed to curtail imports and promote domestic steel production were found to generate significant abnormal returns, albeit with a heterogeneous impact at the firm level.

Research on the US-China trade war in 2018-2019 could explain the variegated results in stock prices on a firm level, found by Lenway et al. (1990). US firms that heavily relied on trade with China, experienced greater declines in market values around the time when higher tariffs were announced. Similarly, Chinese firms integrally exposed to US markets were negatively affected by the introduction of tariffs, particularly for exporting firms. Results were derived by calculating cumulative abnormal returns (CAR) using the capital assets pricing model (CAPM). Exposure of Chinese companies was measured both through direct and indirect supply chain networks, e.g., firms losing sales to downstream firms due to decreased demand from Chinese customers, stemming from the increased tariffs (Huang, 2020). Congruent results were revealed in a study by Crowley et al. (2019) in the Chinese solar panel market. In 2013 the EU introduced import tariffs on Chinese solar panels to counteract the drop in relative market share experienced by European producers. Publicly traded Chinese solar panel companies experienced negative CARs, as measured by the market model, with the magnitude

of this effect exhibiting a positive correlation with the extent of firms' exports to countries within the EU.

3.2 Previous Research on the Effect of Green Policies on Market Returns

Previous research on the market effects to the introduction of government policies intending to combat climate change has yielded mixed results. One study on the Australian Stock Exchange between 2005-2008 found that reactions to a total of 19 different government climate initiatives varied across industries and depending on the proposed policy. However, most of the industries displayed negative abnormal returns following the introduction of the policies intended to mitigate climate change. Among the industries that reacted negatively were oil and gas, real estate, and mining, while sectors such as industrial engineering, media, and auto parts reacted positively. The blended results are possibly explained by polluters being able to pass on carbon costs to customers, rendering green policies to some extent ineffective to create incentives for firms to attenuate their carbon emissions (Vikash et al., 2013). Later empirical research on the Australian stock market has found that the market finds green policy value relevant. An event study surrounding the announcement of the introduction of an Australian Emissions Trading System in March 2008 found that a firm's carbon intensity[1] was statistically significant in predicting the negative abnormal return following the announcement of the ETS (Chapelle & Clarkson, 2013).

Finding empirical evidence of lower market valuation for high emitters in the EU after the implementation of the ETS has proven challenging. This is primarily attributed to the excessive allocation of free allowances during the initial two phases of the program (see Section 2.2). Findings show that the overallocation of free allowances even led to a carbon premium on "dirty" stocks as the surplus allocation allowed carbon-intense firms to sell excess allowances on the European carbon markets. The carbon premium was essentially wiped out with the introduction of the third phase of the EU ETS in March 2009 when the majority of carbon allowances were auctioned out instead of distributed for free (Oestreich & Tsiakas, 2015). Jong et al. (2014) found concurrent results that there was a positive correlation between stock prices and carbon emission allowance prices in the EU in 2006, explained by the overallocation of allowances. This evidence suggests that investors consider the value of allowances in their decision-making process; however, it does not shed light on how investors assess their worth in an environment where emissions carry tangible costs for firms. Clarkson et al. (2015) do however find significant valuation differences for public firms in the EU for the period 2006-2009, depending on the number of emissions exceeding their free allowances. Although this provides an indication regarding the value relevance of the ETS, the scarcity of empirical evidence in this regard is noteworthy. The lack of comprehensive research in this domain underscores the significance of further investigation to unravel the intricate dynamics and

[1] Defined as the amount of emissions the company is responsible for divided by its historical revenue

implications of the ETS in a modern setting with higher prices of emission allowances on the carbon market.

3.3 Possible Effects of a Carbon Border

3.3.1 The Effectiveness of CBAM

Several studies have identified the occurrence of carbon leakage in the EU, with emissions increasing outside of the cap-and-trade system due to the increased cost to emit carbon within the system. Gaska et al. (2019) make predictions on the occurrence of carbon leakage through different channels using a Computable General Equilibrium (CGE) model. They argue that carbon leakage is a serious threat to the ETS, undermining its effectiveness to combat climate change in the EU. The authors also conclude that the EU ETS in the absence of the CBAM creates incentives for other nations to reduce their own climate targets to increase their relative cost advantage to goods produced in Europe. Implicitly, besides companies moving outside the EU to circumvent carbon costs, the EU ETS is at risk of indirectly increasing carbon emissions globally as other nations adopt less ambitious climate policies. Mönsdorf (2022), applying a similar methodology to Gaska et al. (2019), finds that a carbon border adjustment mechanism would be an effective tool and could reduce carbon leakage by a third. Covering indirect emissions would amplify its effectiveness in reducing carbon leakage, albeit at the risk of political and legal repercussions. Kuik & Gerlagh (2003) also find evidence of carbon leakage under the Kyoto Protocol, as a decrease in import tariffs on foreign goods increased the propensity for carbon leakage.

Previous research has examined the potential for retaliatory actions resulting from the introduction of the CBAM. According to Holmes et al. (2011), the probability of disputes around world trade would increase with ambiguities in rules for acceptable carbon border measures set by the WTO. Moreover, the authors raise concerns over reporting issues, formulating a view that if carbon charges are imposed on imported products, current ambiguities surrounding the reporting requirements for emissions open for opportunistic manipulation. Pirlot (2022) concurrently argues that the lack of consistent guidelines in the CBAM proposal, coupled with the legal and institutional complexity, undermines its effectiveness as a tool to incentivize decreased carbon emissions. However, a survey study on key German stakeholders found an overall positive attitude (59%) to the introduction of the CBAM in the EU ETS. Nonetheless, a skeptical cluster of respondents making up around one third of the sample express concerns about the risk that the CBAM may reduce EU competitiveness (Kuehner et al.,2022).

3.3.2 Market Reactions to the CBAM in a non-EU Context

Few studies have been made on the effects on firm valuation following the announcement of the CBAM in the EU ETS. A recent study by Shen et al. (2023) analyze the market reactions for companies listed on China's Shenzhen or Shanghai Stock Exchanges to a series of

announcements by the European Commission on the CBAM. The authors form a dataset of all industrial A-share companies listed on the Shanghai or Shenzhen Stock exchanges, excluding companies that do not disclose data on their share of exports to the EU and exhibit other missing data. The study examines 12 legislative announcements related to the introduction of the CBAM, spanning from the initial EU proposal in December 2019 to a revised proposal in June 2022.

To study the market reaction for listed Chinese firms, the authors estimate CAR with the market model, i.e., observed returns are compared to their expected risk-adjusted market returns. CAR is defined as (1):

(1) $CAR_{ni}[t_1, t_2] = \sum AR_{nit}$

Where Abnormal Returns (AR) are defined as (2):

(2) $AR_{nit} = Rnit - \hat{a}o - \hat{a}_{1}Rnmt.$

The authors find that for 7 out of 12 events, there is a significant negative CAR for the event period, one day before the announcement, the day of the announcement, and three days after the announcement. The results indicate that the proposed introduction of the CBAM in the EU is value relevant for Chinese industrial firms. Little significance is found for the earlier announcements, possibly attributed to investors being unsure of its probability of being adopted and cannot reliably evaluate the impact of the policy. Moreover, the authors find that companies exposed to the EU in terms of exports are more adversely affected. Lastly, the authors find that CAR is more negative for carbon-intensive firms. The findings obtained by Shen et al. provide compelling evidence that investors perceive the CBAM policy as being value relevant and linked to carbon intensity in an international setting. Moreover, their research suggests that this perception is especially pronounced for companies that heavily rely on exports to the EU market. It remains unexplored whether, conversely, EU industrial stocks exhibit a positive reaction to the policy.

3.4 Development of Hypotheses

Classical international trade theory suggests free trade is mutually beneficial for nations as it increases resource efficiency as countries specialize production to what they are comparatively efficient at. Introducing import tariffs gives rise to a deadweight loss, disrupting this efficient resource allocation as production is redistributed to comparatively less efficient domestic manufacturing. This assertion applies to most cases, with the exception being situations where the introduction of tariffs can effectively enhance competition in the domestic market, as argued by Krugman et al. (2022). Empirical studies are consistent with the underlying theoretical frameworks. For instance, the US-China trade war had negative effects on broad US and international stock indices (Boehr et al., 2021), as well as overall US welfare (Amti et al., 2019). Also, previous studies (Lenway et al. (1990), Huang (2020), and Crowley et al.

(2019) have indicated that domestic industries impacted by protectionist trade policies generally experience positive stock reactions.

The research investigating the impact of climate change mitigation legislation on firm valuation have yielded variegated results. For instance, the introduction of an Australian ETS in 2009 resulted in market value penalties for carbon-intensive firms, as indicated by Chapelle and Clarkson (2013). Studies on the valuation effect of the European ETS have been difficult to conduct since the overallocation in phases 1 and 2 of the ETS has permeated later stages of the emissions framework, as the high supply has rendered low ETS certificate prices. However, results have shown there was a valuation premium on carbon-intensive firms between 2006-2009 in the EU due to the overallocation of allowances, at least providing evidence that investors perceive the events as value relevant albeit for a scenario where free allowances exceeded firms' emissions (Oestreich & Tsiakas, 2015; Jong et al., 2014).

Despite the ongoing discussion surrounding the CBAM, first proposed on December 11th 2019, there is a lack of empirical research on how the market anticipates the effects on companies that fall under the policy's scope. Studies conducted to assess the potential impact of the CBAM have mostly been qualitative assessments and statistical predictions using macro-econometric models. Most of these studies suggest that the implementation of the CBAM may reduce carbon leakage (Gaska et al., 2019; Mönsdord, 2022) and even potentially disrupt existing trade agreements (Holmes et al., 2011). However, despite the ongoing discussion surrounding the CBAM, there is a lack of empirical research on how the market anticipates the effects of the CBAM on firms falling under the policy's coverage.

The empirical research gap is significant, as it raises important questions about the potential market reaction to the implementation of the CBAM. It is essential to understand how the market perceives the CBAM, and its potential impact on the affected companies, to better assess the policy's viability and effectiveness as a tool for achieving global carbon reduction goals. Shen et al. (2023) found that Chinese companies exporting to the EU experienced a more negative CAR for legislative announcements around the CBAM, and a more adverse effect for companies with higher carbon emissions intensity. Conversely, it remains unexplored whether there is an opposite, positive, stock market response for European companies safeguarded by the CBAM. Our study aims to fill this apparent research gap. As such, we state the following first hypothesis to be tested:

H1: *Stock prices of firms headquartered within the European Union belonging to industries covered by the CBAM (steel and iron, electricity, fertilizers, aluminum, and cement) will react positively to announcements that enforce the CBAM. This should be the case as import tariffs on carbon emissions in these industries will increase the equilibrium prices within the EU.*

Leaning on classical trade theory and previous empirical research (Lenway et al., 1990; Crowley et al, 2019; Huang, 2020), imposed import tariffs should generate higher prices on the domestic markets in the absence of export rebates, all else equal. This implies that firms with

a significant proportion of their sales within the EU should benefit more from the consequential price increases due to the CBAM tariff. Thus, our second hypothesis reads as follows:

H2: *The market reaction for firms will be correlated with the proportion of sales a firm has within the EU. This should be the case as a larger share of the firm's products will be sold at the new (higher) equilibrium price as a result of the CBAM import carbon tariff.*

Moreover, the CBAM policy is expected to benefit carbon-intensive industries within the EU at an aggregated level, as the tariff will hit non-EU firms within targeted industries that export to EU countries. This is likely to strengthen the competitive position of CBAM industries within the EU to the detriment of CBAM industries outside the EU. However, the carbon intensity of individual firms should not be considered value relevant. This is because the CBAM policy does not provide direct benefits to individual EU-based firms in proportion to their CO2 emissions. Rather than observing the effects of the policy at the individual firm level, it is expected that the impact will be seen at the industry level. Conclusively this establishes our third hypothesis:

H3: *The market reaction to the CBAM will not be industry uniform, i.e., firms covered by the CBAM that belong to an industry that on average is more carbon-intensive should react more positively to the legislative announcements. This should be the case since the emissions intensity of the industry will reflect the carbon surcharge paid by firms exporting to the EU.*

4. Method

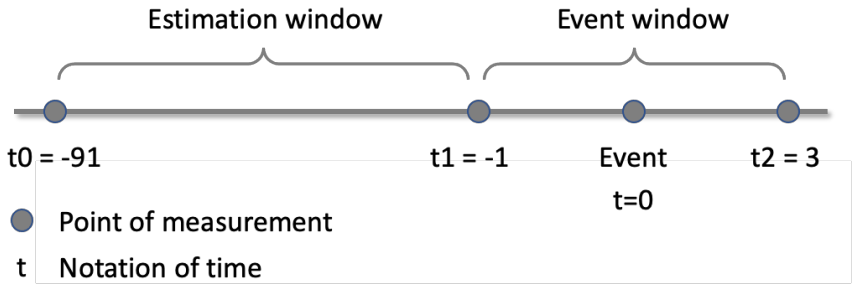
4.1 Event Study Specification

The study is based on an event study methodology to assess investors' perceptions of the EU CBAM legislation initiatives through an examination of the market reaction of firms headquartered in the EU, within the five high-risk industries affected by the CBAM legislation. An event study is a method that evaluates the effect of a particular event on a company's market value by analyzing financial market data (MacKinlay, 1997). In this study, the event of interest is the announcement date of official CBAM legislative announcements.

An efficient market, at least in the semi-strong form, is a prerequisite for conducting an event study on the stock market, meaning that stock prices reflect all publicly available information and adjust instantly and fairly to relevant events. Hence, by examining the prices of securities within a relatively brief time frame, it is possible to create a metric for the economic impact of an event (MacKinlay, 1997). The event study aims to examine the market reaction to the specific announcements by aggregating abnormal returns over a specific period. This is done using a metric called Cumulative Abnormal Return (CAR), which is a widely used measure in short-term event studies (Foster, 1979). More specifically, this involves calculating the CAR during both an estimation window and an event window, which covers the identified event dates. Further details on the methodological specifications are discussed in the sections below.

4.2 Determination of the Event and Estimation Windows

Figure 1: Event study design



The study utilized an event study methodology to evaluate how CBAM legislative announcements deemed to increase the likelihood of the policy's implementation are incorporated into the equity market. This approach involves analyzing financial market data to determine how a particular event affects a firm's value. By studying the stock prices over a short and specified period, the economic impact of the event can be measured. If the event is value relevant, its effects should be immediately reflected in the stock prices. The primary objective of an event study is to compare the realized return of securities that are subject to the event with the expected return of the same securities if the event had not occurred, also known

as the "normal" return. Any difference in returns can be attributed to the event itself and is referred to as the abnormal return. The returns are defined as the closing stock price (day 0), divided by the closing price on the previous trading day (day -1).

Generally, a standard event study consists of: (i) an estimation window; and (ii) an event window (see Figure 1). The event window typically covers one or more days, including the date of the event itself. In this study, the event date is the day on which the EU discloses each of the CBAM-related legislative decisions within the sample of 14 announcements (see Table 1). For this study, the event window consists of a 5-day-trading interval [-1,3] covering the announcement date [0], in order to capture any information leakage or post-announcement drifts in cumulative abnormal returns. The narrow event window also increases the preciseness and minimizes the risk of major confounding events, reducing the probability of contamination (K.R. Ahern, 2009).

Multiple economic models used to compute CAR rely on historical information to estimate returns. Thus, an estimation window covering historical trading days must be established to complete the event study parameters. Based on previous research (Krivin et.al., 2003), the estimation window in this study consists of a total of 90 trading days, starting 91 days before the event and ending 2 days before the event [-91, -2], which enables detection of any potential information leakage or insider trading pre-event.

4.3 Identification of CBAM Legislative Events

The development of the EU CBAM has been a lengthy and complex process that began in 2019 and is still ongoing. To determine relevant legislative events that could affect the likelihood of the EU passing the CBAM policy, a comprehensive search was conducted covering events between 2019 and 2022. A total of 14 significant events were identified that provided valuable information on the probability of the legislation being passed. More specifically, the study included 12 significant events that were identified through an analysis of prior research conducted by Shen et al. (2022). In addition to those, two additional recent events were deemed significant and were included in the study. To assess the impact of each event, the directional effect on investors' expectations was evaluated and the market reactions were aggregated across all 14 events. Table 1 provides a detailed overview of the CBAM legislative events included in the study.

Table 1. Market reactions to 14 legislative events affecting the likelihood of passage of EU CBAM

No.	Event date	Description	Assessed likelihood of passing the CBAM	Expected CAR coefficient
1	Dec 11, 2019	The EU CBAM is first proposed by the European Commission as part of the European Green Deal.	Increase	+
2	Sep 16, 2020	European Commission President Ursula von der Leyen announces a legislative proposal on the EU CBAM as part of key new initiatives for 2021.	Increase	+
3	Oct 19, 2020	In the EU's 2021 Work Program, the European Commission plans to table a legislative proposal for the CBAM and the CBAM as an EU resource in the second quarter of 2021.	Increase	+
4	Feb 5, 2021	ENVI adopts a report titled "Towards a WTO-Compatible EU Carbon Border Adjustment Mechanism" with 58 votes for, 8 votes against, and 10 abstentions.	Increase	+
5	Mar 10, 2021	The European Parliament passes a nonbinding resolution supporting the introduction of a CBAM compatible with the World Trade Organization ("Towards a WTO-Compatible EU Carbon Border Adjustment Mechanism").	Increase	+
6	Jul 14, 2021	The European Commission adopts its proposal for a CBAM, which would equalize the price of GHG emissions between domestic products and imports in five sectors, and an impact assessment accompanying the proposal that confirms the target sectors most at risk for carbon leakage and the most feasible option for a CBAM (option 4)	Increase	+
7	Nov 29, 2021	INTA releases its draft opinion on the EU CBAM proposal (released on July 14, 2021).	Increase	+
8	Dec 21, 2021	ENVI releases its draft opinion on the EU CBAM proposal (released on July 14, 2021).	Increase	+

9	Feb 28, 2022	INTA narrowly votes against an opinion on its draft opinion report for the EU CBAM proposal (released on July 14, 2021) and thus does not contribute to ENVI's draft report on the subject with 19 votes for, 20 votes against, and 3 abstentions	Decrease	-
10	Mar 15, 2022	The Council of the European Union reaches an agreement (general approach) on the EU CBAM and releases its compromise text, which reflects the Council's position for negotiations to agree on a final regulation text (the so-called trialogue discussions) among the Commission, the Parliament, and the Council.	Increase	+
11	May 17, 2022	ENVI adopts its draft report on the EU CBAM proposal (released on July 14, 2021) with 49 votes for, 33 votes against, and 5 abstentions.	Increase	+
12	Jun 22, 2022	The European Parliament adopts its position on the regulation establishing the EU CBAM with 450 votes for, 115 votes against, and 55 abstentions.	Increase	+
13	Dec 13, 2022	The European Parliament reached a provisional agreement with the EU to implement the EU CBAM, covering the product categories of iron and steel, aluminum, fertilizers, hydrogen, and electricity, effective from 1 October 2023	Increase	+
14	Dec 18, 2022*	The European Parliament and the Council reached a provisional agreement on an EU ETS reform and phasing out of free allowances, which will start in 2026 and end in 2034. Businesses will therefore be required to purchase CBAM certificates for covered imports from 2027.	Increase	+

* Announcement on Dec 18 but the following trading day was Dec 19

4.4 Measurement of Abnormal Returns

To quantify the effect of the specific events, it is necessary to compute a metric for abnormal return, which is calculated by subtracting the expected normal return of the company from the actual return achieved during the event window. This study relies on the market model for modelling the normal return, since the model is advantageous due to the high precision it provides in measuring abnormal returns. By eliminating the portion of the return that is linked to the variation in the market's return, the market model decreases the variance of the abnormal returns, leading to an enhanced ability to identify the economic effects of the event. Thus, the

market model is advantageous to alternatives such as the constant mean return model, and any multifactor model, which rarely offer any significant analytical improvements (MacKinlay, 1997). The market model is specified by equation (1):

(1) $R_{nit} = \alpha_0 + B_0 R_{nmt} + \varepsilon_1$

In the model, three indices are utilized to track stock returns. The first index, denoted by the variable "i", refers to different firms of the population in the dataset. The second index, "t", corresponds to the various trading days over the period of analysis. The third index, "n", represents a specific event, where n can take on values from 1 to 14. We denote the stock return of company i on day t for event n with the symbol "R_{nit}". The market return on the t-th trading day, denoted as R_{nmt}, is based on a value-weighted portfolio of all stocks. To estimate R_{nit}, we use a window ranging from 91 days to 2 days before the event date for each company. This estimation period is denoted as [-91, -2]. Equation (1) is used to estimate the regression coefficients, $\hat{a}_0$ and $\hat{B}_0$, of each firm event. Subsequently, the excess return of company *i* on each trading day *t* around event *n* is calculated using Equation (2):

(2) $AR_{nit} = R_{nit} - \hat{a}_0 - \hat{B}_0 R_{nmt.}$

4.4.1 Aggregation of Abnormal Returns

The returns must be aggregated further in order to analyze the impact of the announcements on the returns of the treatment group in the sample. Furthermore, an aggregation enables controlling if firm-specific factors influence abnormal returns and studying the effect of the event over multiple periods. This study utilizes [–1, 3] as the main event window but other event windows are also applied to check the robustness of our primary conclusions. A time-series aggregation across the event window for each panel observation enables controlling for firm-specific factors that may drive abnormal returns and studying the event's effect over multiple periods. To achieve this, we calculate the cumulative abnormal return by employing the following methodology (equation 3):

(3) $CAR_{ni}\,[t_1, t_2] = \sum_{t=t1}^{t2} AR_{nit}$

Where
AR_{nit} = the abnormal return for firm i at day t, associated with the n-th event
(t_1, t_2) = the event window specification
CAR_{ni} = the cumulative abnormal return for firm i associated with the n-th event identified in the EU CBAM legislative process

4.4.2 Determining the Statistical Significance of CAR

The common denominator of the firms in the treatment group of the sample is their inclusion in the CBAM policy's scope, implying that for each CBAM announcement, all firms' stock prices are affected by the same market information at the same time. Thus, having the same event date for all firms means that stock prices violate the assumption of independence, causing cross-correlation and downward-biased standard errors. Correspondingly, this increases the appearance of type 1 errors of over-rejection of the null hypothesis (Kolari & Pynnönen, 2010). The preferred approach to counteract cross-correlation is to apply standardized abnormal returns (Kolari & Pynnönen, 2010), which is calculated by dividing abnormal returns by the standard deviation of abnormal returns. This method also has the benefit of mitigating the issue of heteroskedasticity in returns. In this study, to test if the observed cumulative abnormal returns significantly differ from zero, a t-test is applied. Subsequently, the CAR for each event is divided by the standard error to determine its statistical significance.

4.5 Regression Model

4.5.1 General regression model

To investigate the association between abnormal returns and the list announcement, we employ a multivariate regression analysis. The general ordinary least-squares multivariate regression equation (4) can be represented as follows:

(4) $$y_{i,t} = \alpha + \beta_1 x_{1,it} + \cdots + \beta_k x_{k,it} + \varepsilon_{i,t}$$

Several assumptions are made regarding the model. These assumptions include the absence of autocorrelation (meaning that the error terms are uncorrelated), homoscedasticity (indicating constant variance in the error term), no multicollinearity (relying on independence among the explanatory variables), no correlation between the error term and explanatory variables, and normally distributed error terms (Brooks, 2014). However, depending on the characteristics of the sample, adjustments may be required in the econometric model to account for any violations of these assumptions.

4.5.2 Specific Regression Model

To separate the effect of the CBAM from industry-specific characteristics, ordinary least squares regressions are performed for the purpose of this study, as specified in Equation (5).

(5) $$CAR_{i,n} = a_0 + \beta_1 CBAM\_INDUSTRY_{i,n} + \beta_2 \sum Controls + \delta_i + \gamma_n + \varepsilon_{in}$$

The dependent variable, CAR_{in}, represents the CAR for firm i during the [-1, 3] window surrounding the n-th event, specifically based on a sample of EU-headquartered listed firms,

across all industries. Thus, the primary independent variable of interest is *CBAM_INDUSTRY* which takes a value of 1 for firms operating within any of the five high-risk industries targeted by the CBAM policy (treatment group), and 0 for all companies outside these industries (control group). The identification criteria are established as follows: a company is considered a CBAM company if its primary business area (during the most recent financial year) involves cement, iron and steel, aluminum, fertilizers, electricity and/or hydrogen. If a company's primary business area was outside these industries during the last financial year, it is identified as a non-CBAM company. Our coefficient of interest is $\beta 1$, which measures the difference in CAR between the treatment and control groups following the announcement of the EU CBAM event.

To test H2, we incorporate an interaction variable, CBAM_INDUSTRY x EU_SALES, into the model to examine the correlation between the proportion of sales within the EU and the market reaction to the EU CBAM. Equation (6) is specified as follows:

(6) $$CAR_{i,n} = a_0 + \beta_1 CBAM\_INDUSTRY_{i,n} + \beta_2 EU\_SALES + \beta_3 CBAM\_INDUSTRY_{i,n} \text{ x } EU\_SALES + \beta_4 \sum Controls + \delta_j + \gamma_n + \varepsilon_{in}$$

Where *EU_SALES* represents the proportion of sales that the firm has within the EU, calculated as the percentage of sales within the EU during the latest financial year.

Furthermore, based on previous research (e.g., Ayers et.al., 2003; Flammer, 2013), several company and individual stock characteristics are included as control variables in the model to control for factors other than the EU CBAM that may influence abnormal returns. These control variables include total revenue (*SALES*), firm size (*SIZE*), the book-to-market ratio (*BM*), return on total assets (*ROA*), earnings per share (*EPS*), and leverage (*LEV*) (e.g., Shen et al., 2022; Fama & French, 1992). The variable *SIZE* is included since larger firms on average yield lower returns than smaller firms (Fama & French, 1992), thus we expect the variable to be negative. The book-to-market (*BM*) ratio is included as firms with a high BM ratio on average tend to yield higher returns than firms with a low BM ratio (Fama & French, 1992), and is therefore expected to be positive. Moreover, firms with a higher ROA tend to be more profitable, which usually is incorporated into their stock prices, causing stock returns to be lower. Thus, *ROA* is included as a control variable with an expected negative relationship with abnormal returns. *EPS* is another included control variable expected to be negatively correlated with abnormal returns as higher EPS tends to be reflected in a higher stock price. Moreover, higher relative financial leverage is another variable that is asserted to increase a firm's benefits from imposed trade protections due to increased product prices. However, the benefits of increased expected returns may not be fully captured by the equity holders, and part of the increase in wealth is expected to be captured by debt holders due to decreased probability of default (Lenway et al., 1990). Hence, the control variable for leverage (*LEV*), is included in the model. The definitions and measurement of variables are summarized in Table 2. Specifically, *SIZE* represents the natural logarithm of total assets, *LEV* is total liabilities divided by total book value of equity, *BM* is the ratio of the book value of equity to the market value of equity,

ROA is the ratio of net income to total average assets, and *EPS* is the weighted average of the current net profit, divided by the total number of outstanding common shares.

Table 2. Definition of variables

Variable	Definition	Expected sign
CAR[-1,3]	The cumulative abnormal returns of the company over [–1, 3] days associated with each event identified in the EU CBAM legislative process; abnormal returns are calculated with the market model	n.a.
CBAM_INDUSTRY	A dummy variable that equals 1 if the main business area of the company involved any of the 5 industries targeted by the CBAM during the previous financial year	+
EU_SALES	A variable representing the percentage of sales within the EU during the previous financial year	+
SALES	The total revenue in EURm during the previous financial year	+
SIZE	The natural logarithm of the total assets of the company the previous year that the n-th event of the EU CBAM is announced	-
LEV	The ratio of total debt to book value of equity at the end of the previous year that the n-th event of the EU CBAM is announced	+
BM	The ratio of the book value of equity to the market value of equity at the end of the previous year that the n-th event of the EU CBAM is announced	+
ROA	The ratio of net income to total average assets at the end of the previous year that the n-th event of the EU CBAM is announced	-

EPS	The weighted average of the current net profit attributable to holders of outstanding common shares at the end of the previous year that the n-th event of the EU CBAM is announced	-

To enhance the reliability of our findings, unobservable industry-level factors that may impact the dependent variable are taken into account by including industry fixed effects (δj) in our robustness analysis (see section 6.4) (Wang & Chou, 2018). Standard errors are calculated using a heteroscedasticity-consistent covariance matrix and clustering them at the industry level. Lastly, ε_{in} represents the unobserved error term in the regression model.

4.6 Sample and Data

The initial dataset consists of all active listed companies headquartered within the EU. To ensure the reliability and validity of the analysis, a set of criteria is applied to select the final sample of companies. When testing our second hypothesis, we exclude companies in affected industries that do not disclose data on the composition of their sales by region in their prospectus or annual reports. Second, we eliminate companies with fewer than 95 trading days (covering the estimation and event windows). Third, we drop companies with missing data on control variables. We source data on regional sales and dual listing from the Capital IQ database, verifying and supplementing regional sales data from the annual reports of listed companies to ensure analytical accuracy. Moreover, the Fama French industries classifications were applied to allocate individual firms into 12 relevant industries, in order to cluster standard errors and robustness checks with industry fixed effects.

5. Descriptive Statistics

Our sample consists of 3,017 panel observations of EU-headquartered listed firms and a total of 2,120,008 observations. Out of 3,017 included companies, 73 operate within CBAM industries, over the period 2019-2022. The descriptive statistics of the sample and relevant control variables are summarized in Table 3, and the statistics for our subset of CBAM industries are visualized in Table 4. The primary results visualized by the descriptive statistics refer to the average 5-day CAR measure in relation to the 14 identified CBAM legislative events as.

Table 3[(1)]. Descriptive statistics (total sample)

Variable	Obs.	Mean	Median	Std. Dev.	Min	Max	P25	P75
CAR [-1, 3][(2)]	3017	-.001	-0.001	0.018	-.001	-.001	-0.091	0.007
SALES (EURm)	3017	2373.73	81.530	9579.849	-304[(3)]	167362	11.880	680.470
ROA	3017	0.048	0.026	0.121	-1.799	0.745	-0.003	0.051
LEVERAGE (D/E)	3017	18.726	0.507	52.352	0	138	0.183	0.987
BOOK TO MARKET	3017	1.592	0.620	20.193	0	1515.15	0.310	1.140
MARKET CAP (EURm)	3017	2813.38	80.040	12028.44	.03	366251.94	14.260	731.470
EPS (EUR)	3017	-.148	0.140	80.466	-8714.73	827.29	-0.020	0.860
LN TOTAL ASSETS (EURm)	3017	5.089	4.820	2.692	-2.47	13.87	3.190	6.950

(1) Table 3 represents summary statistics for the variables. Refer to Table 2 for definitions of variables.
(2) CAR[–1,3] is based on the market model over the event window [–1, 3], calculated as the average CAR calculated for firms within high-risk industries over all 14 events
(3) Negative Min sales referring to an investment company for which capital IQ reports a holding loss directly recorded as revenues

Table 4. Descriptive statistics (CBAM firms)

Variable	Obs.	Mean	Std. Dev.
SALES (EURm)	73	3180.2	12345.5
ROA	73	0.02	0.084
LEVERAGE (D/E)	73	0.9	1.0
BOOK TO MARKET	73	1.8	4.5
MARKET CAP (EURm)	73	1705.2	4764.2
EPS (EUR)	73	1.4	7.7
LN TOTAL ASSETS (EURm)	73	5.8	2.5

The industries in our sample of listed firms headquartered within the EU are derived using the Fama French 12 industry classification, which categorizes firms into 12 broad industries. As can be seen in Figure 2, finance (584), utilities (415), consumables (412), telecommunications (321), retail (238), and manufacturing (231) industries are overrepresented in the sample. Furthermore, our sample of CBAM industries is skewed towards steel & iron, and electricity, as can be seen in Figure 3. Thus, the skewed nature of the distributions stresses the importance to further control for this characteristic.

Figure 2. Industry composition (total sample)

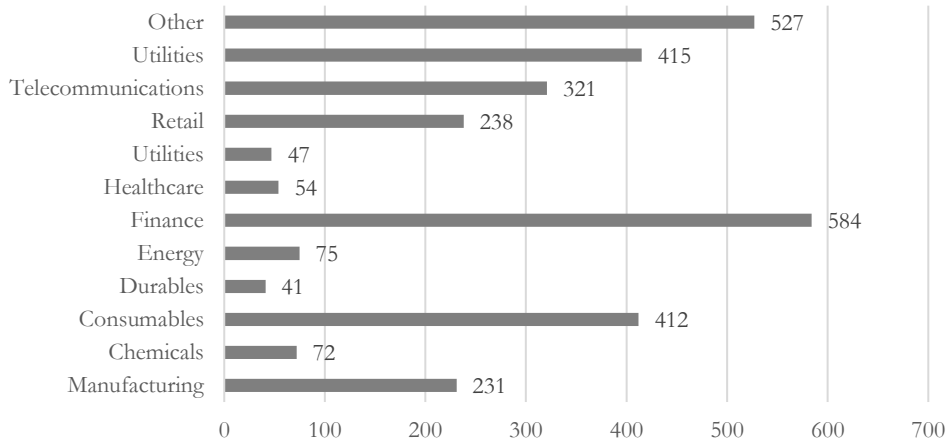
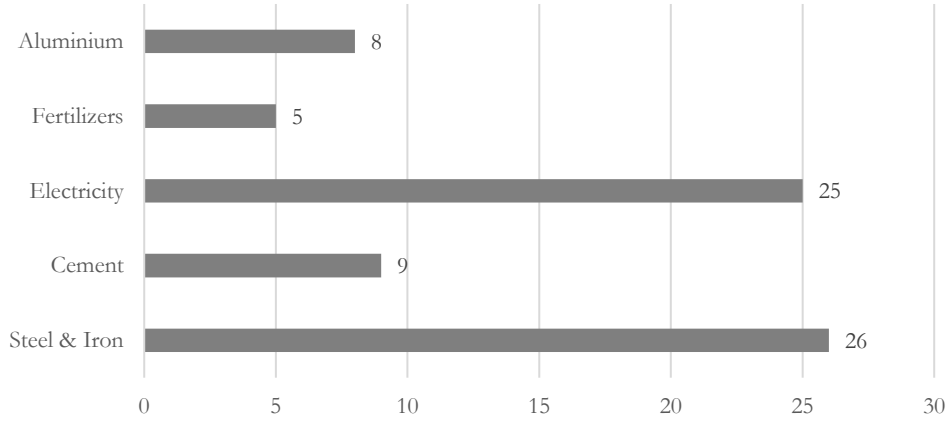


Figure 3. Industry composition (CBAM industries)



6. Results

6.1 Cumulative Abnormal Returns and the CBAM

To test our first hypothesis, we evaluate the event period CARs of the CBAM companies over a 5-day window around the 14 legislative CBAM events. The results are summarized in Table 5. Overall, we identify significant CARs around 4 out of the 14 events (see Figure 4), 2 of which are negative (-0.94% and -4.63%), and 2 of which are positive (1.27% and 6.20%). In general, a pattern of increasing effects on the significant CARs is observed for later events in the sample of announcement dates, with the strongest effect on CAR observed for Event 9, which also has the strongest level of significance (+6.20%, $p<0.01$), followed by CAR for Event 12 (-4.63%, $p<0.05$), event 11 (+1.27%, $p<0.05$), and event 6 (+0.94%, $p<0.05$). The average CAR for CBAM firms across all 14 events is negative (-0.10%), but not significant. Thus, on an aggregate level it is not possible to statistically conclude whether the EU CBAM policy announcements are informationally relevant for EU-headquartered companies within CBAM industries.

Specifically, in the early to mid-stage development of the CBAM policy (from December 2019 to March 2021, events 1–5), no significant CARs are observed for the treatment group firms' stocks post-announcements. As mentioned in the background section, the first acknowledgement of the CBAM proposal occurred on December 11, 2019, and did not become an official EU legislative proposal until September 16, 2020. On the date of our first significant CAR, July 14, 2021 (Event 6), the EU commission officially adopted the proposal of a CBAM for the first time, as part of the "Fit for 55" package. Embedded in this announcement, an official draft of the EU CBAM was released, highlighting the key features of the policy. This signals that investors don't find the CBAM legislative announcements as value relevant for the CBAM firms during the early proposal stages of the policy. No significant results are observed before the first official adoption of the CBAM proposal by the EU commission, when the treatment companies significantly underperformed their counterparts, yielding a negative CAR of -0.94%. Contradictory to our expectations, a significant positive CAR of 6.2% is obtained for the treatment companies after the committee on international trade (INTA) voted against the EU CBAM proposal on February 28, 2022 (Event 9). This signals that investors contrary to our belief view the EU's adoption of the CBAM as negative for the treatment companies from a firm valuation perspective, which is elaborated upon more granularly in the discussion (Section 7). However, in line with our expectation, the treatment companies yielded a significant positive CAR of 1.27% after the Committee on the Environment, Public Health and Food Safety of the European Parliament (ENVI) adopted a draft report on the CBAM proposal on May 17, 2022 (Event 11), which signals that investors, on the contrary, had a positive sentiment towards the policy. Finally, a negative CAR of -4.63% was obtained in relation to the EU parliament's adoption of a position in support of the CBAM regulation, after a large majority voting for the regulation (Event 12). Thus, the significant CARs generally depict a negative investor sentiment towards the CBAM policy, since 3 out of 4 results reflect negative/positive market reactions to an increased/decreased likelihood of the adoption of the

CBAM policy (refer to Figure 4). This is in conflict with our expectations of a general positive investor sentiment towards the implementation of the policy.

Figure 4. Significant CARs [-3,1] per event

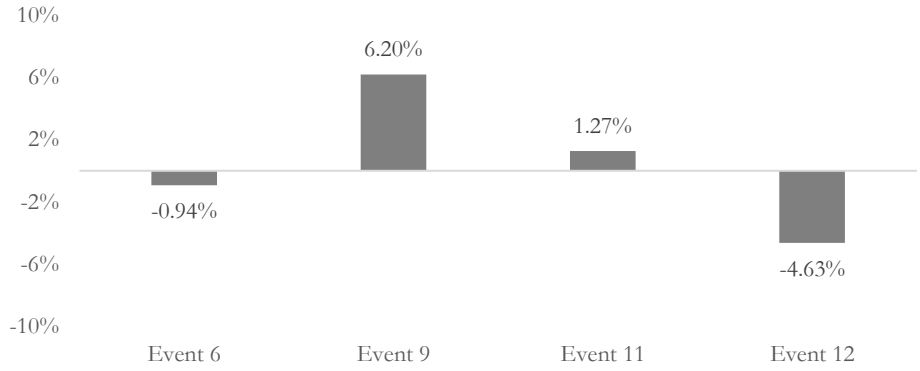


Table 5. CAR across all events

CBAM-related event	**Event 1**	**Event 2**	**Event 3**	**Event 4**	**Event 5**	**Event 6**	**Event 7**	**Event 8**	**Event 9**	**Event 10**	**Event 11**	**Event 12**	**Event 13**	**Event 14**
Date	11/12/19	16/09/20	19/10/20	05/02/21	10/03/21	14/07/21	29/11/21	21/12/21	28/02/22	15/03/22	17/05/22	22/06/22	13/12/22	18/12/22
Predicted sign	+	+	+	+	+	+	+	+	-	+	+	+	+	+
CAR [-1, 3]	-7.22	.194	-0.0512	-0.623	-0.126	-0.942*	-0.714	-0.012	6.202***	-0.952	1.265**	-4.627**	0.421	-0.012
CAR [-1, 0]	0.212	0.434	0.127	-0.223	-0.582	-0.003	-0.508	0.132	2.493***	-0.796	0.082	-2.438***	-0.088	-0.323

*** p<0.01, ** p<0.05, * p<0.1*
CARs multiplied with a factor of 100 for readability

6.2 Regressing Industry Categorization on CAR

As a method to separate the effect of the EU CBAM from industry-specific characteristics, we performed ordinary least squares regressions for the treatment company group. Firstly, we conduct a regression with clustering of standard errors on an industry level, based on the Fama French 12 industry classifications, excluding any fixed effects. The results can be found in Table 6. In contrast to the main findings of the CAR model, the regression analysis reveals a significant CAR only for one event (Event 9), with a positive regression coefficient of 0.203. This to some extend validates the result of our primary analysis as Event 9 is the date on which the committee on international trade (INTA) voted against the EU CBAM proposal which we hypothesized should lead to a negative reaction. We however note that for no other events, a significant effect could be found. This discrepancy from our primary results, where significance was observed for four events, is most likely attributed to the application of clustering of standard errors at the industry level in our regression, hence controlling and accounting for potential correlation within industries.

Furthermore, as a means of conducting a robustness check on the regression analysis, we employed a shorter event window by isolating the observation to the trading day immediately preceding the event and the trading day of the event itself [-1, 0]. Conclusively the adjusted regression model mirrors the directional effects on the CARs observed in the original regression, however failing to yield statistically significant results for all events (refer to table 6). This underscores the insignificance found in regressing the industry variable indicating whether a firm belongs to the affected industries on CAR for the CBAM-related events.

Table 6. Regressing CBAM dummy on CAR

CBAM-related event	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14
CBAM dummy	1.354	4.611	1.340	-0.546	1.672	1.028	4.316	-75.712	20.272*	26.854	10.522	12.025	119.854	102.705
Sales	-0.000	-0.000	0.000	-0.000	0.000	0.000	-0.000	-0.001	0.000	0.001	0.000	-0.002	0.000	0.000
ROA	-1.931	13.234	19.971	1.134	15.000	5.192	-2.405	-116.153	283.709	535.243	270.731	172.380	-294.354	-281.420
Leverage	-0.000*	-0.000	0.000*	-0.000***	0.000	0.000**	0.000	-0.000	0.001	0.002	0.001	0.001	0.000	0.000
Book-to-market	0.050***	-0.176	0.015*	0.042***	-0.480	0.025***	-0.197	-0.136	-0.187	-0.380	-0.188	-0.076*	0.207	0.159
Market Cap	-0.000	0.000	-0.000	0.000	0.000**	0.000**	0.000*	-0.003	0.000	0.000	-0.000	-0.000	0.001	0.001
EPS	0.039***	0.001	0.045***	0.047***	-0.027	0.001	0.000	0.014	0.342	0.648	0.345	0.406	0.022	0.016
LN Total Assets	1.403	0.429	0.008	0.050	-0.010	-0.168	0.313	33.386	-3.594*	-5.754*	-1.240	-0.415	21.213	15.620
Constant (α_0)	-9.953	-6.930	-2.046	-0.508	-1.222	-1.192***	-6.454	-108.491	-0.475	-7.896	-8.560	-11.524	-238.728	-190.413
Observations	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008

*** p<0.01, ** p<0.05, * p<0.1*
CARs multiplied with a factor of 100 for readability

Table 7. Regression table using different event window [-1, 0]

CBAM-related event	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14
CBAM dummy	0.951	1.657	0.373	-0.168	0.658	0.349	2.246	1.759	18.342	7.869	6.285	6.900	35.731	44.183
Sales	-0.000	-0.000	0.000	-0.000	0.000	-0.000	-0.000	0.000	0.000	0.000	0.000	-0.001	0.000	0.000
ROA	-2.327	2.316	6.547	-0.714	8.924	2.427**	-0.336	-3.155	329.282	161.366	169.209	94.625	-107.267	-114.003
Leverage	-0.000**	0.000	0.000	-0.000***	0.000	0.000***	0.000	-0.000	0.001	0.001	0.001	0.000	0.000	0.000
Book-to-market	0.003	-0.041	-0.000	0.044***	-0.295	0.016***	-0.098	-0.050	-0.211	-0.115	-0.116	-0.037**	0.027	0.077
Market Cap	-0.000	0.000*	0.000	0.000*	0.000*	0.000	0.000**	0.000	0.000	0.000	-0.000	-0.000	0.000	0.000
EPS	0.018***	0.002***	0.028***	0.021***	-0.016	0.001	0.000	-0.000	0.402	0.195	0.209	0.225	0.004	0.007
LN Total Assets	0.661	0.076	-0.104***	0.028	0.071*	-0.053	0.096	0.190	-3.593*	-1.797*	-0.708	-0.343	4.339	7.500
Constant	-4.408	-1.635	0.136	-0.276	-1.231	-0.145	-3.109	-2.681	-3.349	-2.332	-6.127	-5.374	-59.961	-86.641
Observations	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008

*** p<0.01, ** p<0.05, * p<0.1
CARs multiplied with a factor of 100 for readability

6.3 Returns and Share of Sales in the EU

Our second hypothesis aims to examine the potential association between the proportion of sales within the EU and the magnitude of abnormal returns observed for treatment firms. Results are shown in Table 8. Our findings reveal noteworthy results for Events 2 and 14, indicating a statistically significant negative relationship at the 10-percent and 5-percent levels, respectively. In the case of Event 10, a positive association is observed, suggesting that a 10% increase in the share of sales leads to a 0.73 higher CAR, all else being equal. However, it is important to note that for most events, there is a lack of statistically significant evidence linking CAR and the proportion of sales within the EU for CBAM companies. Standard errors are clustered on the 12 industry categories as defined by Fama & Frhiench and do not include fixed effects. For firms, disclosing a detailed sales split for key regions is not a requirement. As such only 50 firms' share of sales of CBAM companies could be included based on information gathered from their respective annual accounts and S&P Capital IQ. Since only the share of sales occurring within the EU is included for CBAM firms the industry dummy and the variable describing the sales split is dropped from the regression.

Our initial hypothesis is predicated upon the premise that firms with a greater proportion of sales within the EU are likely to experience a correspondingly heightened level of impact and, consequently, elicit a more pronounced response to the proposal. However, against the background of our conflicting empirical findings (a statistically negative coefficient and positive coefficient for Event 10 and Event 14 respectively), we critically question the underlying simplicity upon which this hypothesis is constructed, and further underscore the intricacies associated with the CBAM (discussed upon in more detail in Section 7.1).

6.4 The Effect across CBAM Industries

Forming separate dummies for each of the CBAM industries allows us to observe any potential difference in CARs between industries. The industry dummies are included in a joint regression without a constant and display how CAR varies between industries. Standard errors are robust and not clustered on industry. The results, shown in Table 9, show that the effects are similar across all industries. The lack of significance for the regression on fertilizer industry firms is likely due to the limited number of listed companies with available data; only 5 in total. Comparing the average CAR across all industries, the coefficients are within an interval of +- 0.01 of each other.

Table 8. Regression table from incorporating share of sales

CBAM-related event	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14
EU_SALES	2.919	-6.372*	1.357	-5.289	1.005	0.612	-2.216	5.476	-6.788	7.288**	-0.602	2.286	4.372	-7.006**
Sales	-0.000***	0.000	0.000***	0.000*	0.000**	0.000***	-0.000	0.000	0.000***	-0.000	-0.000**	-0.000	0.000	0.000
ROA	-2.606	2.774	0.811	-9.946*	5.287**	7.555*	6.918***	4.397	-1.020	4.814	10.744**	3.040	4.113	-3.522
Leverage	-0.218	1.693	0.208	-0.499	0.173	-0.648**	-0.192	-0.344	-1.345	0.950	-0.284	2.248	-1.141	0.564
Book-to-market	-0.042	0.022	0.022	-0.122	0.378***	0.045	-0.194***	-0.095	-0.112	-0.084***	-0.122***	0.161	-0.080	0.003
Market Cap	-0.000	0.000	-0.000	-0.001*	0.000***	-0.000***	-0.000	-0.000	-0.001*	0.000	0.000**	0.000	-0.000	0.000
EPS	0.075***	0.008	0.025*	0.020	-0.045***	-0.043***	-0.053***	-0.013	0.108	-0.036**	-0.011	0.058	-0.069	-0.005
LN Total Assets	0.425	-1.390***	-0.141	0.729	-0.653**	0.044	-0.030	0.169	0.710	-0.313	-0.134	0.143	0.228	-0.684***
Constant (α_0)	-4.625	11.310***	-0.189	1.038	1.452	-1.015	1.607	-4.372	10.063	-4.463	1.982	-10.0***	-3.066	8.502**
Observations	35,890	35,890	35,890	35,890	35,890	35,890	35,890	35,890	35,890	35,890	35,890	35,890	35,890	35,890

*** p<0.01, ** p<0.05, * p<0.1
CARs multiplied with a factor of 100 for readability

Table 9. Regression table of each high-risk industry

CBAM-related event	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Mean CAR all events
Steel & Iron dummy	3.307***	7.361***	3.310***	1.320***	0.729	1.617***	4.232	-50.253	27.842***	29.856***	14.477***	13.149**	129.01***	110.57***	21.181***
Electricity dummy	2.169**	3.697	0.659*	-2.422***	2.382***	1.118*	4.471	-46.948	20.674***	32.038***	15.635***	12.435*	133.709***	108.105***	20.552***
Fertilizer dummy	-0.932	5.610	2.787***	-0.496*	0.567	1.463	2.921	-51.356	26.360**	36.243	14.307	11.648	127.934	114.902	20.854
Aluminum dummy	0.894	2.648	0.194	-2.287***	2.998***	-0.158	4.959	-48.842	18.845*	37.746**	14.791	17.177*	129.316*	106.639*	20.351*
Cement dummy	4.090***	4.129	1.207**	1.339***	2.830***	-0.336	5.069	-48.034	15.165	32.815*	14.209	16.901	131.602*	110.830*	20.844**
Observations	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008

*** p<0.01, ** p<0.05, * p<0.1
CARs multiplied with a factor of 100 for readability

6.5 Further Analysis

In our study, a series of robustness tests are conducted to control for a different set of model specifications. Firstly, we have performed the study under two separate event windows. Our main analysis is centered around a 5-day event window [-1, 3] built upon previous research by Shen et al. (2023). The second event window constructed is a two-day event window [-1, 0] over which abnormal returns are cumulated. The estimation window of 90 days [-91, -2] is the same for both tests. The shorter event window captures the immediate reaction to the announcement on each date. The results from utilizing a shorter event window can be seen in Table 5 and Table 7, and do not differ significantly from the results of our main event window.

Further, we perform a series of alterations of our regression analysis revolving around the first hypothesis, regressing CAR on our CBAM dummies. The results from the regressions can be found in the Appendix. Firstly, the CBAM dummy is regressed on CAR, including fixed effects based on the Fama & French 12 industry codes (Table A1). Including industry fixed effects in the regression allows for controlling and accounting for unobserved heterogeneity and idiosyncrasies specific to each industry, thereby reducing potential bias and providing more reliable estimates of the relationships between the independent and dependent variables. A significant positive effect on the 10-percent level for Event 3 is found, whereas all other results are statistically insignificant. Secondly, the CBAM dummy is regressed with only robust standard errors (no clustering) and including industry fixed effects (Table A2). Coefficients from these regressions are statistically significant on the 1-percent level for all events except Event 14. The notable difference in statistical significance when using robust standard errors but not when clustering standard errors on industry suggests that the observed significance may be driven by heteroscedasticity or within-industry correlation. Clustering the standard errors on industry appropriately captures this correlation, leading to a reduction in the estimated significance levels. By accounting for the potential correlation within industries, the significance tests become more conservative, which we argue reflects a more accurate assessment of the statistical significance of the estimated coefficients. Thirdly, the CBAM dummy is regressed on CAR with robust standard errors and without fixed effects (Table A3). The results from this regression resonate with the results in Table A2, with high statistical significance for all estimated variables. This further suggests that clustering of standard errors is appropriate to account for heteroscedasticity and within-industry correlation. Lastly, our main model regression to test hypothesis 1 (i.e., clustering of standard errors on industry and excluding fixed effects) is modeled without control variables (Table A4). No significant results are then found for any of the events.

7. Discussion

7.1 Evaluation of Results

We start to study the CAR for companies operating within industries impacted by the CBAM. Our findings reveal that 4 out of the 14 analyzed events exhibit statistical significance, with 3 demonstrating coefficients indicating a prevailing investor sentiment opposing the adoption of the policy. Adding depth to our analysis through event-specific CAR regressions provides additional nuance, wherein only one event remains positively statistically significant at the 10-percent level (Event 9), which is the date on which INTA voted against the CBAM proposal. Furthermore, exploring an alternative event window [-1, 0] reveals no significant outcomes, and conducting a regression without control variables also fails to yield any significant effects. Our second hypothesis was to explore whether the number of sales a company has in the EU would affect the size of the CAR coefficient. Based on our results it is hard to discern this relationship. The test of our third hypothesis indicates that the effect is more industry uniform than predicted. We expected that effects would vary more across industries due to differences in carbon intensity and the implicit effect of the policy in each industry. Analyzing how material the differences are for each industry requires a deeper dive into the carbon intensity of each industry in relation to other costs of production as well as the decarbonization possibilities for each industry. The carbon intensity of each industry remains outside the scope of this study and opens up further research possibilities as to what is driving this effect.

Despite observing significant results for certain events, we remain skeptical regarding the confirmation of our first hypothesis. The foundation on which we built our hypothesis relies on the classical Ricardian view on trade espoused by Krugman et al. (2022). According to this theory, an import tariff, all else being equal, is expected to yield positive outcomes for the industry by reducing competition from exporting companies, raising equilibrium prices, and consequently enhancing implicit profits on sales. Empirical evidence from historical instances in the US (Lenway et al., 2019), Europe (Crowley et al., 2019), and China (Huang, 2020), supports this prediction. However as seen in our literary review, when it comes to the introduction of green policies, research has yielded ambiguous findings, also because of historical policies failing to sufficiently impact carbon-intense industries (Oestreich & Tsiakas, 2015; Jong et al., 2014). However, Clarkson et al. (2015) find significant valuation differences for public firms in the EU depending on the number of emissions exceeding possessed free allowances, supporting the view that carbon-intense firms are penalized under an emissions trading scheme. Simultaneously, Shen et al. (2023) find a significant negative CAR for Chinese firms across events increasing the likelihood of the CBAM being implemented. We argue for three different possible explanations as to why our results show no significant results for most dates, and a significant positive CAR for Event 9 when the CBAM policy was rejected by INTA.

Possible explanation 1: The advancement in the CBAM legislative process cements the ETS as an integral part of the EU's strategy to combat climate change

Since its inception in 2005, the EU ETS has failed to exert a substantial impact on carbon-intensive industries, primarily due to the issue related to the excessive allocation of free allowances (Misch and Wingender, 2021). Additionally, the ETS has encountered challenges from industries being incentivized to relocate their production outside the EU to countries with laxer emissions regulations. The CBAM aims to address precisely this issue. One plausible explanation for not observing a significant positive return could be that investors perceive the CBAM not solely as a policy that theoretically favors the treatment group companies. Rather, investors may view it as an indicator of the EU's intent to shape its climate policy landscape around the ETS, which if fully implemented would yield significant cost increases for CBAM companies. Therefore, our contention is that the implied benefits of the CBAM are counterbalanced by the EU's simultaneous advancement of the ETS, despite the expectation that the policy should be advantageous to the affected industries from a Ricardian perspective. The positive CAR observed surrounding the date of INTA's vote against the CBAM proposal, as indicated both by the mean CAR across affected companies (significant at a 1-percent level) and the regression of an industry dummy on CAR (significant at a 10-percent level), supports this argument.

This is also evidenced by a negative sentiment for the ETS and CBAM among industry associations. The Swedish industry association Svenskt Näringsliv writes in a report (2023, p. 10), *"ETS and CBAM will increase the cost of steel and aluminium in Europe and could thus make investment in clean energy power plants, and automotives, more expensive, which will make the EU less competitive".* This underlines our argument that advancement in the legislation for the CBAM should not be perceived not as a separate policy but in conjunction with the EU centering its climate policy around the ETS. Consequently, the introduction of a carbon border within the EU may not be comprehended solely through a lens of an import tariff; rather, we emphasize the complexities associated with the CBAM policy being a cornerstone of the EU's climate policy, which may prompt investors to incorporate additional factors into their pricing considerations.

Possible explanation 2: Political retaliation and lobbying may lead investors to incorporate additional factors in their pricing considerations

One potential explanation for not obtaining a significant mean CAR over the 14 observed events could possibly be derived from the ambiguities and risks associated with the complex global political landscape. Investors might fear that the CBAM would trigger political retaliation from other political blocks such as the US or China. For instance, the US has responded by implementing the Inflationary Reduction Act (IRA) in January 2023, aimed at making the US the go-to place for green investments by linking subsidies and tax credits to domestic production. The policy is described as one of the most significant climate legislations in US history (United States Environmental Protection Agency, 2023), and CBAM critics have expressed concerns that investment in the affected sectors within the EU might be postponed as companies reassess their investment plans and prioritize the establishment of production

facilities in the US to capitalize on available subsidies. The potential consequences of this could result in a lack of capital and raw materials, constraining production growth and undermining the overall competitiveness of the EU, thus potentially undermining the primary objectives of the CBAM policy (Svenskt Näringsliv, 2023). Moreover, despite the obvious benefits of import tariffs as a crucial mechanism for safeguarding domestic industries, theory suggests that the introduction of tariffs such as the EU CBAM risks a spiral of retaliations from other countries, potentially escalating into a trade war (Krugman et al., 2022). Henceforth, according to theory, the potential long-term consequences of tariffs are often multifaceted and difficult to anticipate.

Another possible explanation for the insignificant average observed CAR in this study could be that investors expected significant lobbying against the CBAM, thus undermining the policy's credibility and assessed likelihood of being implemented. E.g., ahead of voting on more ambitious EU climate policies (including the EU CBAM) in June 2022 (Event 12), EU lawmakers received numerous requests and solicitations from lobbyists, with some industries urging a scaleback of the proposals (Abnett, 2022). Especially the proposed gradual phase-out of free ETS allowances received objections from many associations representing energy-intensive industries such as the European Steel Association (EUROFER), the European Chemical Industry Council (Cefic), and the European Cement Association (Cembureau), who criticized the pace of the proposed phase-out. Additionally, these influential industry associations' lobbying against the phase-out of free ETS allowances likely served as a potent signaling mechanism to the stock market, in line with the disposition discussed in *possible explanation 1*. Nevertheless, such signaling would be contradictory to conventional international trade theory and the EU's communication of the CBAM as a measure aimed at enhancing the competitiveness of EU industries, as the intention of the policy is to benefit the affected domestic high-risk industries, not to undermine them. Thus, also these paradoxical signaling could potentially serve as explanations for the absence of significant results in the study, with the exception of one event (Event 9).

Moreover, the foundational doctrine of the WTO, included in the most-favored nation (MFN) principle found in Article I of the General Agreement on Tariffs and Trade (GATT), states that any concession granted to one member must be extended to all members, forbidding any discrimination among countries. Another principle of non-discrimination is the national treatment rule, outlined in Article III of the GATT, stipulating that internal regulations should not favor domestic goods or production over imported products. Hence, the CBAM might face challenges in providing protection for domestic industries through the implementation of import tariffs on foreign products. Additionally, it is probable that certain emerging economies will bring the CBAM proposal before the WTO, and if the WTO would rule against the policy, the EU will be forced to decide whether to alter the CBAM to comply with the prevailing trade regulations. Beyond the unresolved legal concerns, the broader impact of the CBAM on the international trading system remains uncertain. According to the CSIS Scholl Chair, there are three potential scenarios that the CBAM could cause: (1) "a race to the top" scenario where non-EU countries adopt more ambitious climate policies; (2) a scenario characterized by mutual recrimination, where countries resort to increasingly protectionist trade measures; or

(3) a scenario that largely maintains the status quo (CSIS, 2023). Only time will tell which scenario emerges.

Conclusively, the political factors might diminish the credibility and potency of the EU CBAM, making it difficult to estimate and quantify the long-term implications of the policy, thereby undermining its informatory value. As a result, the ambiguous outcomes of the CBAM policy may lead to confusion among investors, which could explain why we only obtained a significant result for only one event (Event 9) in the study.

Possible explanation 3: Implementation issues and ambiguousness entangled with communication of the CBAM policy

As mentioned in the literary review (Section 3), critics argue that the CBAM policy lacks consistent guidelines, and that the legal and institutional complexity undercuts the policy's effectiveness as a mechanism to incentivize decreased carbon emissions (Pirlot, 2022). Additionally, one third of the respondents in a study on key German stakeholders expressed concerns about the potential negative effect of the CBAM on the competitiveness of the EU (Kuehner et al., 2022). Except for any potential informatory deficiencies in the communication of the CBAM, information asymmetries associated with the accounting for Co2 emissions, ETS and overall climate impact have been detected. For instance, in a study conducted by Black (2013), accounting issues related to a significant lack of uniformity, standardization in reporting, and disclosure of ETS accounting were detected in several companies' financial reports. Also, according to the report, many companies lacked sufficient disclosure of both direct and indirect greenhouse gas emissions tied to their operations. Hence, adequate sustainability data such as CO2 intensity is often lacking, potentially causing information asymmetries towards investors. Moreover, many of the firms within our treatment group have a low market capitalization and lower analyst coverage, trading liquidity and overall information transparency. Conclusively, the presence of implementation issues, informational ambiguity, and potential information asymmetry may contribute to the absence of consistent market reactions observed across the sample of events on average. This could also explain why only one event (Event 9) exhibits a statistically significant CAR.

In addition to the three explanations presented in detail above we present a fourth on which the efficient market hypothesis does not hold. Implicitly, news related to CBAM are value relevant and new, but investors do not perceive this. Given the results of our study, we cannot with certainty discard this as a potential explanation for our null results. The probability of this being true could be exacerbated by the inclusion of small-market cap listed companies in the study, with low analyst coverage and trading volumes, albeit the average sales being more than 3 bn EUR for our treatment firms. In summary, we present four possible explanations for our results, summarized below in Table 10.

Table 10. Possible explanations for our results

Possible Explanations I & II		
Value relevant and new information?	EMH assumption	Interpretation of results
Information on the EU CBAM legislative process is value relevant for shareholders and poses new and value relevant information to shareholders	The stock market immediately reacts and incorporates the information into stock prices, thus resulting in abnormal returns and the EU legislative announcements are an observable source for investors to collect information about potential effects on the firm's financial performance	i)The CBAM being a cornerstone of the EU's climate policy may prompt investors to incorporate additional factors into their pricing considerations. ii) Lobbying from incumbents and trade retaliation may prompt investors to incorporate additional factors into their pricing considerations
	Possible Explanation III:	
Value relevant and new information?	EMH assumption	Interpretation of results
Information on the EU CBAM legislative process is not new and value relevant information for shareholders	Investors do not react to the information, since they already have collected information on the EU CBAM legislative process from other sources, and/or they do not find the events value relevant. Thus, no abnormal returns are observed	Lacking clarity around legal and accounting issues in conjunction with low credibility for the EU may prompt investors to view the proposal as not having a material impact on firms' financial performance
	Possible explanation IV	
Value relevant and new information?	EMH assumption	Interpretation of results
Information on the EU CBAM legislative process is value relevant for shareholders and poses new and value relevant information to shareholders	Investors do not have access to perfect information and cannot perceive the potential effects of the policy	The efficient market hypothesis does not hold as there is no reaction to new value relevant information that has a material impact on affected companies' financial performance

7.2 Evaluation of Method

7.2.1 Measuring Expected Returns

Expected return estimates can vary significantly depending on which model is applied. I.e., specification problems have been identified associated with the market model, which is applied in this study. In many cases, residual correlation, heteroskedasticity and nonlinearity have been identified to be associated with the application of the market model (Coutts et.al., 1994). Thus, we make some reservations considering the validity of applying the market model as a tool for estimating expected returns. The validity of the expected return partly dictates the validity of the abnormal return. Thus, employing several models for robustness testing is a common validation method. However, MacKinlay (1997) argues that using multifactor models in short-term event studies does not significantly enhance results compared to the market model (a single-factor model). Hence, after considering MacKinlay's statement and evaluating the marginal benefit of incorporating multifactor models, we have concluded that their inclusion is not justified in this study.

7.2.2 Measuring Aggregated Abnormal Returns

The validity of the findings in this study is contingent on ensuring the proper estimation of the dependent variable - the aggregated abnormal return. Therefore, it is essential to consider the adequacy of the model utilized for estimating expected returns, as well as the methodology employed to cumulate abnormal returns. These factors play a critical role in determining the validity and reliability of our results. To address this issue, we have conducted an additional analysis with a shorter event window. This yielded no significant differences in the results derived from the study.

7.2.3 General Concerns with Short-term Event Studies

In addition to the biases that may be associated with the procedures of cumulating abnormal returns, short-term event studies are generally associated with methodological issues such as confounding events, systematic biases, and the width of the event windows (Ding et.al., 2018). Confounding events imply that external events or factors occur simultaneously or close in time with the event of interest, which can influence the observed results. Thus, these events can create challenges in attributing the observed effects solely to the event being studied, as their presence can confound or distort the results. Another inherent assumption in the event study methodology is the absence of competing information or confounding events that impact stock returns during the event window. To mitigate this concern, we applied a shorter event window [-1, 0] as a robustness check, but did not find any significant deviations. However, it is important to acknowledge that broader market-wide news could introduce noise during the event window, challenging the assumption of no competing information and presenting a limitation in our study.

Systematic bias refers to a consistent deviation of the estimated outcomes of an event from the true population parameters, caused by factors that consistently influence the results in a distinct direction. In a short-term event study, the bias can occur due to reasons such as sample selection bias, survival bias, endogeneity bias, or data measurement bias. Although the analysis focuses on a relatively short timeframe, the selection of firms for the study can be influenced by survival bias (Brown and Warner, 1980). Thus, if certain firms are excluded from the analysis due to failure (or similar) before the event, the remaining sample may not be representative of the broader population, leading to biased results. However, since the CBAM policy is not scheduled for implementation until 2026, one could argue that financially distressed firms are of less importance for the sample selection, as the policy's long-term effects will only affect surviving firms. To mitigate pre-event survival bias, the sample selection methodology should carefully be evaluated and ensured to adequately represent the population of interest.

Data measurement bias refers to errors or biases in the measurement or collection of data, which can distort the results in the statistical analysis. The bias is mitigated in this study by utilizing a sample selection as broad as possible, thus better representing the target population. Overall, to mitigate systematic biases, we have adopted a comprehensive approach by analyzing a broad dataset, including all listed active firms in the CBAM industries within the EU. Furthermore, we have benchmarked this sample against all listed active firms across all industries in the EU. However, we are aware that this approach can cause other measurement biases associated with the quality of individual data points in the sample, such as trading statistics and the exclusion of firms with lacking financial information for our control variables. Finally, it is important to acknowledge the possibility of data handling errors in any quantitative research. Conducting a stock market event study involves handling a large volume of individual stock data, especially in this study given the large sample selection, and involves performing several data aggregation steps, increasing the risk of data handling errors.

7.2.4 General Limitations

Naturally, this study has limitations stemming from both the inherent assumptions of the event study research method as well as methodological considerations in estimating abnormal returns.

Limitation 1: Efficient Market Hypothesis (EMH)

A distinct limitation is that the event study methodology relies on the assumption of market efficiency (EMH), with the underlying presumption that the expected “normal” return would be the true fundamental return if a studied event would not have occurred (Brown and Warner, 1980). Thus, an event study simultaneously tests the market efficiency and the inherent validity and reliability of the model of expected return itself. However, many studies have provided evidence against the EMH (e.g., Fama & French, 1992), thus questioning the adequacy of assuming that the market is efficient. However, this so-called “bad-model” issue is less severe for short-term event studies, such as our event study design (Fama, 1998). However, we cannot,

considering our result, with certainty discard the possibility that the market efficiently incorporates the true effects of the proposed implementation of the CBAM.

Limitation 2: *Independently and Identically Distributed Data (IID)*

Another limitation is associated with our assumption of Independently and Identically Distributed (IID) data, implying an inherent assumption that the observations in our sample are independent of each other and drawn from the same probability distribution. The assumption of independence is questionable since there is a probability of autocorrelation between timely observations of one individual, e.g., since control variables such as company assets tend to correlate over time, thus violating the IID assumption. To account for this, we cluster standard errors at the industry level when estimating the coefficient in our regression analysis of CARs.

Limitation 3: Endogeneity

Furthermore, the assumption of exogeneity is a crucial inference in any regression model, referring to the condition where the independent variables are not correlated with the error term in the regression model. Exogeneity is important for valid statistical analysis and unbiased estimations, since it assures that the independent variables are purely casual factors affecting the dependent variable. However, endogeneity, occurring when the independent variables are correlated with the error term, is a common violation of the exogeneity assumption, which can arise due to errors or systematic biases, such as selection bias. To address the endogeneity bias, we model industry fixed effects as a robustness check. By incorporating these fixed effects, we can account for unobserved industry-specific factors that may be correlated with both the independent variables and the error term, thereby reducing the risk of endogeneity bias. This approach helps strengthen the exogeneity assumption, enhancing the validity and robustness of our statistical analysis and providing more reliable and unbiased estimations of the causal relationships between the variables of interest.

Limitation 4: Generalizability of our results

Results obtained from an EU setting cannot be readily extrapolated to other contexts, e.g. the US, due to significant institutional differences between the markets. Despite that our study benefits from a large sample of EU firms that is representative of the population, the applicability of our findings to other geographical settings is limited. This limitation stems from the divergent regulatory frameworks, economic structures, and political dynamics between the EU and other political actors. For instance, the unique characteristics of the US market, including the absence of a comparable policy like the CBAM, the adoption and implementation of such a measure in the US seems less likely. Therefore, caution should be exercised in generalizing our results beyond the European context, as the institutional disparities and political landscape may yield different outcomes and implications for firm valuation.

8. Conclusion and Further Research Suggestions

In this study, we examine the market reactions to the European Union's (EU) proposal of implementing a carbon-specific import tariff (CBAM) on goods from carbon-intensive industries. Our analysis focuses on a series of 14 legislative events spanning from 2019 to 2022. While existing research extensively explores market responses to trade policies and environmental initiatives, no previous study has investigated the market reaction specifically to a carbon emissions-targeted import tariff on the European securities market. Utilizing an event study methodology, our findings do not suggest that the events are associated with a significantly positive cumulative abnormal return (CAR), as hypothesized. Rather, three out of four events indicate a negative investor sentiment toward the proposal. However, performing a regression analysis with clustered standard errors on the industry level, we find largely statistically insignificant coefficients except for one instance (Event 9). Alternative analyses and robustness tests did not yield significant effects. The relationship between the proportion of sales in the EU and the CAR coefficient was inconclusive, and the policy's effect was more uniform across industries than hypothesized. In light of our conflicting results, we are skeptical about the confirmation of our hypotheses.

Assuming the efficient market hypothesis holds, we provide three possible explanations for why the market reaction to a carbon import tariff implemented under the EU ETS might deviate from that anticipated by Ricardian trade theory and previous empirical trade research. Firstly, the integration of the CBAM legislation may not only be perceived by investors as a standalone policy but also in conjunction with the EU's focus on the ETS as a central element of its climate strategy. The phasing out of free emission allowances within the ETS has adverse effects on the financial performance of affected firms due to escalating carbon costs. Consequently, the progression of CBAM legislation solidifies the EU's commitment to the ETS as a key tool in combating climate change, potentially offsetting the anticipated positive market reactions associated with protectionist trade policies. Secondly, the political dimension of CBAM may prompt investors to factor in the risks of trade wars hindering companies' exports, while lobbying activities could undermine the policy's overall effectiveness. Lastly, we address the challenges related to implementation, such as accounting complexities and information asymmetry. These complexities may lead investors to perceive the policy as having limited value or insignificant impact.

Our contribution to the literature is significant, as research focused on the intersection of sustainability and trade policies is limited. One study (Shen et al., 2023) finds compelling evidence indicating a significant and proportionally larger negative abnormal return associated with the implementation of the CBAM for Chinese industrial firms. Our study is the first to examine the stock market effects of a carbon border tariff on the market on which it is implemented. Given the prominent research gap and the limited findings provided by this study, we suggest that future research delve into qualitative investigations aimed at obtaining a deeper understanding of investor expectations regarding the CBAM policy. Moreover, once the policy is implemented, exploring alternative quantitative approaches and analytical methods such as Tobin's Q or multifactor models could prove insightful, as more data will be

available. Lastly, incorporating data on CO2 emissions for industries could provide valuable insights into the relationship between environmental performance and stock market effects in the context of the CBAM policy. Analyzing the overall industry carbon intensity and available decarbonization paths could add additional depth into understanding the effects of the policy for each CBAM industry.

Conclusively, our study provides insights into the market reactions to the proposed CBAM policy in the EU. These results have several interesting implications in terms of the impacts of the policy on firms based in the EU. From a practical standpoint, these results underscore the need for careful evaluation and monitoring of the CBAM policy's effectiveness in achieving its intended objectives.

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Appendix

Table A.1: Regressing CBAM dummy on CAR, clustered standard errors on industry and industry fixed effects based on Fama & French 12 industries

CBAM-related event	**Event 1**	**Event 2**	**Event 3**	**Event 4**	**Event 5**	**Event 6**	**Event 7**	**Event 8**	**Event 9**	**Event 10**	**Event 11**	**Event 12**	**Event 13**	**Event 14**
CBAM dummy	-0.420	0.833	2.125*	0.541	0.141	-0.333	-0.354	-59.251	7.338	2.921	-1.519	68.608*	-0.849	0.138
Sales	-0.000	-0.000	0.000	-0.000	0.000	0.000	-0.000	-0.001	0.000	0.000	0.000	-0.002	0.000	0.000
ROA	-0.603	17.852	20.738	1.526	15.950	5.674	1.046	-137.182	237.871	447.839	223.011	188.719	-444.871	-382.694
Leverage	-0.000***	-0.000	0.000**	-0.000***	0.000	0.000***	0.000	-0.002***	0.001	0.002	0.001	0.001	-0.001	-0.001
Book-to-market	0.047***	-0.176	0.015*	0.044***	-0.482	0.023***	-0.199	-0.090	-0.213	-0.429	-0.212	0.021	0.048	0.030
Market Cap	-0.000	0.000	-0.000	-0.000	0.000*	0.000*	0.000	-0.003	0.000	0.001	0.000	-0.000	0.001	0.001
EPS	0.039***	0.002	0.044***	0.047***	-0.027	0.001	0.001	0.041**	0.342	0.647	0.345	0.403	0.045	0.037
LN Total Assets	1.111	0.555	0.054	0.082	-0.220	-0.291	0.404	32.835	-3.638*	-5.850*	-1.299	0.410	20.256	14.757
Constant (α_0)	-8.437	-7.439**	-2.288***	-0.695*	-0.138	-0.541	-6.822**	-107.164	0.323	-6.369	-7.751	-17.112**	-230.20**	-183.0***
Observations	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008

*** p<0.01, ** p<0.05, * p<0.1
CARs multiplied with a factor of 100 for readability

Table A.2: Regressing CBAM dummy on CAR, robust standard errors and industry fixed effects based on Fama & French 12 industries

CBAM-related event	**Event 1**	**Event 2**	**Event 3**	**Event 4**	**Event 5**	**Event 6**	**Event 7**	**Event 8**	**Event 9**	**Event 10**	**Event 11**	**Event 12**	**Event 13**	**Event 14**
CBAM dummy	-0.420***	0.833***	2.125***	0.541***	0.141**	-0.333***	-0.354***	-59.25***	7.338***	2.921***	-1.519***	68.608***	-0.849***	0.138
Sales	-0.000***	-0.000***	0.000***	-0.000***	0.000***	0.000***	-0.000***	-0.001***	0.000***	0.000***	0.000***	-0.002***	0.000	0.000***
ROA	-0.603	17.852***	20.738***	1.526***	15.950***	5.674***	1.046***	-137.2***	237.87***	447.84***	223.01***	188.72***	-444.9***	-382.7***
Leverage	-0.000***	-0.000***	0.000***	-0.000***	0.000***	0.000***	0.000***	-0.002***	0.001***	0.002***	0.001***	0.001***	-0.001***	-0.001***
Book-to-market	0.047***	-0.176***	0.015***	0.044***	-0.482***	0.023***	-0.199***	-0.090***	-0.213***	-0.429***	-0.212***	0.021***	0.048***	0.030***
Market Cap	-0.000***	0.000***	-0.000***	-0.000	0.000***	0.000***	0.000***	-0.003***	0.000***	0.001***	0.000***	-0.000***	0.001***	0.001***
EPS	0.039***	0.002***	0.044***	0.047***	-0.027***	0.001***	0.001***	0.041***	0.342***	0.647***	0.345***	0.403***	0.045***	0.037***
LN Total Assets	1.111***	0.555***	0.054***	0.082***	-0.220***	-0.291***	0.404***	32.835***	-3.638***	-5.850***	-1.299***	0.410***	20.256***	14.757***
Constant (α_0)	-8.437***	-7.439***	-2.288***	-0.695***	-0.138	-0.541***	-6.822***	-107.7***	0.323	-6.72**	-7.751***	-17.1***	-230.2***	-183.0***
Observations	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008

*** p<0.01, ** p<0.05, * p<0.1
CARs multiplied with a factor of 100 for readability

Table A.3: Regressing CBAM dummy on CAR, robust standard errors and no fixed effects

CBAM-related event	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14
CBAM dummy	1.354***	4.611***	1.340***	-0.546***	1.672***	1.028***	4.316***	-75.712***	20.272***	26.854***	10.522***	12.025***	119.854***	102.705***
Sales	-0.000***	-0.000	0.000***	-0.000***	0.000***	0.000*	-0.000***	-0.001***	0.000***	0.001***	0.000***	-0.002***	0.000	0.000***
ROA	-1.931***	13.234***	19.971***	1.134***	15.000***	5.192***	-2.405***	-116.15***	283.709***	535.243***	270.731***	172.380***	-294.35***	-281.42***
Leverage	-0.000***	-0.000***	0.000***	-0.000***	0.000***	0.000***	0.000***	-0.000***	0.001***	0.002***	0.001***	0.001***	0.000***	0.000***
Book-to-market	0.050***	-0.176***	0.015***	0.042***	-0.480***	0.025***	-0.197***	-0.136***	-0.187***	-0.380***	-0.188***	-0.076***	0.207***	0.159***
Market Cap	-0.000***	0.000***	-0.000***	0.000***	0.000***	0.000***	0.000***	-0.003***	0.000***	0.000***	-0.000***	-0.000***	0.001***	0.001***
EPS	0.039***	0.001***	0.045***	0.047***	-0.027***	0.001***	0.000**	0.014***	0.342***	0.648***	0.345***	0.406***	0.022***	0.016***
LN Total Assets	1.403***	0.429***	0.008	0.050***	-0.010	-0.168***	0.313***	33.386***	-3.594***	-5.754***	-1.240***	-0.415***	21.213***	15.620***
Constant (α_0)	-9.953***	-6.930***	-2.046***	-0.508***	-1.222***	-1.192***	-6.454***	-108.50***	-0.475	-7.896***	-8.560***	-11.524***	-238.72***	-190.41***
Observations	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008

*** p<0.01, ** p<0.05, * p<0.1
CARs multiplied with a factor of 100 for readabiliy

Table A.4: Regressing CBAM dummy on CAR, clustered standard errors on industry, excluding control variables

VARIABLES	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14
CBAM dummy	2.423	5.094	1.796	-0.411	1.780	0.972	4.405	-48.876	22.763	32.417	14.818	13.828	130.714	109.689
Constant (α_0)	-3.143	-4.903	-1.846*	-0.208	-1.877	-1.908*	-5.108	48.874	-16.605	-33.355	-13.559	-18.422	-130.305	-109.776
Observations	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008	2,120,008

*** p<0.01, ** p<0.05, * p<0.1
CARs multiplied with a factor of 100 for readability