Cross-Border Carbon Pricing, Decarbonization, and Emissions Disclosure

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PRELIMINARY DRAFT – DO NOT DISTRIBUTE

July 30, 2026

*Corresponding author: rraney@iese.edu. We appreciate helpful comments from Martin Jacob, Aneesh Raghunandan (discussant), and seminar participants at the 2026 EAA Annual Congress. Robert Raney acknowledges financial support from the Spanish Ministry of Science and Innovation, Grant PID2019-111143GB-C31 funded by MICIU/AEI/ 10.13039/501100011033 and Grant PID2023-150744NB-C41 funded by MICIU/AEI/ 10.13039/501100011033. Declarations of Interest: none.

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Abstract

This paper examines how border carbon adjustments affect foreign suppliers' decarbonization and emissions-disclosure decisions. We study the European Union's Carbon Border Adjustment Mechanism (CBAM), the first large-scale implementation of a border carbon adjustment. Using product-level export data to identify non-EU firms treated by the CBAM, we find that treated firms reduce emissions intensity relative to comparable firms following the regulation. The decarbonization response is stronger among firms with pre-existing emissions disclosure and narrower portfolios of CBAM-covered products, consistent with emissions information infrastructure and reporting complexity shaping the costs and returns to abatement. Reductions are also stronger among firms with relatively lower pre-CBAM emissions intensity, where reporting actual emissions may be more advantageous to the firm. We further find that previously non-disclosing treated firms are more likely to initiate emissions disclosure after the CBAM. This disclosure response is also stronger among firms with observable EU customer relationships and relatively lower emissions intensity. Overall, our evidence suggests that cross-border carbon pricing can incentivize foreign supplier decarbonization and emissions information production, while highlighting the importance of firms' emissions reporting environments in shaping both responses.

Keywords: sustainability reporting, carbon border adjustment, carbon pricing, CBAM

1. Introduction

Carbon pricing has become a central policy instrument for governments seeking to reduce greenhouse gas emissions and transition toward lower-carbon economies. By assigning a cost to emissions, carbon pricing internalizes costs of carbon-intensive production and provides firms with market-based incentives to abate emissions (Brink et al., 2016; Andersson 2019; Li et al. 2021; Dang et al. 2023; Martinsson et al. 2024). Its adoption, however, remains uneven, with substantial variation in global coverage, scope, and price levels.[1] This fragmentation creates competitive distortions and can shift carbon-intensive production to regions with weaker climate policies ("carbon leakage"), thereby undermining the effectiveness of domestic pricing regimes and imposing unintended economic costs on regulated sectors (Dechezleprêtre et al. 2022). Border carbon adjustments (BCAs), an emerging policy instrument, seek to address these concerns by requiring importers to pay a carbon price for emissions embedded in imported goods, thereby narrowing differences in carbon costs between domestic and foreign production.

A BCA differs fundamentally from conventional carbon pricing instruments such as a carbon tax or emissions trading system. Under traditional carbon pricing, compliance obligations generally fall on the emitting firm and rely on emissions information generated or controlled within that firm's organizational boundary.[2] In contrast, under a BCA, importers typically bear the formal reporting and payment obligations, while foreign suppliers generate the priced emissions and control the information needed to accurately quantify them. We expect that the effectiveness of a BCA, therefore, depends not only on whether importers can transmit decarbonization pressure to upstream suppliers, but also on whether upstream suppliers can (or choose to) provide credible

[1] For a comprehensive overview of global carbon pricing please see The World Bank State and Trends of Carbon Pricing Dashboard at https://carbonpricingdashboard.worldbank.org/.
[2] This is in line with the fundamental principle of the United Nation's environmental policy that "*the polluter should, in principle, bear the cost of pollution*" (United Nations 1992, principle 16).

emissions information. The value of lower emissions is likely not realizable without CBAM compliant emissions information, creating an interdependency between abatement and information production. Although prior research examines the design and theoretical impacts of BCAs (Fowlie et al. 2021; Bellora and Fontagné 2023; Clora et al. 2023), decarbonization and changes in emissions disclosure among foreign suppliers after implementation of a BCA remain largely untested. In this paper, we examine whether BCA exposure induces foreign suppliers to decarbonize and to initiate public emissions disclosure, and whether these responses vary with differences in suppliers' pre-CBAM emissions reporting environment.

We examine our research questions in the context of the European Union's Carbon Border Adjustment Mechanism (CBAM), the first large-scale implementation of a BCA adopted by the EU in 2023.[3] The CBAM initially applies to EU imports of specific products from six emissions-intensive sectors ("CBAM Products," listed in Appendix B). The CBAM requires EU firms that import CBAM products ("EU Importers") to report embedded emissions and purchase certificates to cover the emissions embedded in such products. Although EU Importers bear the formal compliance obligation, satisfying the CBAM's reporting and verification requirements depends on foreign exporters' ability and willingness to measure, document, verify and communicate product-level emissions information.[4] When compliant information is unavailable, importers may rely on prescribed default values that are intentionally set at high levels to increase the implicit carbon

[3]As a global leader in carbon pricing, concerns about competitive distortions and carbon leakage are particularly salient for the EU (Naegele and Zaklan 2019; Borghesi et al. 2020; Colmer et al. 2024). However, the EU is not along in implementing a BCA. Various policymakers globally are also considering their own BCAs; the UK and Norway committed to launching national BCAs by 2027; Taiwan is working on implementing legislation for a BCA; and other major economies including Australia, Canada, and the United States are in various stages of formal evaluation processes of BCAs (IETA 2024).
[4] Covered emissions generally include direct emissions from the production process (Scope 1) and indirect emissions from purchased electricity and heat (Scope 2). For certain "complex goods" the embedded emissions also include emissions from raw materials that are CBAM goods themselves (i.e. some upstream Scope 3 emissions may also be included).

cost of the imported product and limit any benefits from non-reporting. These features make the CBAM a useful setting for examining how differences in firms' emissions reporting environment shape foreign suppliers' decarbonization and disclosure responses to a BCA.

We expect the CBAM to create incentives for foreign suppliers to reduce the emissions embedded in CBAM Products. Lower emissions can reduce the carbon costs associated with those products and improve suppliers' competitiveness relative to higher-emissions suppliers or substitute products. These incentives should be stronger for firms with greater existing exposure to EU importers. We also expect that economic benefits from lower emissions depend on suppliers' ability to measure, document, verify and communicate emissions that satisfy the CBAM reporting requirements. Abatement and emissions reporting are therefore complementary: when compliant reporting is costly or infeasible, suppliers may be unable to obtain a lower CBAM-related carbon cost even after reducing emissions, weakening their incentive to undertake abatement in the first place. The CBAM may therefore induce foreign suppliers to increase both emissions reduction and emissions measurement and reporting.

The costs and benefits of producing CBAM-relevant emissions information are likely to vary across firms. Pre-existing emissions-information infrastructure may reduce the incremental cost of reporting, while broader product portfolios may increase the complexity of product-level measurement and allocation. The benefits of reporting actual emissions may also be greater for relatively cleaner suppliers whose emissions compare favorably with prescribed default values.

Nonetheless, several features of the CBAM make these effects uncertain. First, the policy depends on EU importers' ability to pass carbon costs upstream or otherwise exert meaningful pressure on non-EU suppliers, for example through pricing, contracting, or the threat of switching suppliers or products. The extent to which EU importers can do this is unclear, with prior work suggesting investors expect EU firms to disproportionately bear the costs of the CBAM (Alonso et al. 2026). Second, because the CBAM certificate price is tied to allowance prices in the EU ETS, it reflects abatement costs and market conditions within the EU rather than those faced by non-EU suppliers. The resulting carbon-price signal may be poorly aligned with foreign suppliers' marginal abatement costs and benefits and not induce a meaningful response. Finally, the CBAM's disclosure-only transitional phase through 2025 may delay both abatement and reporting responses as firms await greater regulatory certainty and the onset of payments for embedded emissions before undertaking costly operational or reporting infrastructure changes.

Even if incentives are transmitted, suppliers' responses may not vary systematically with their pre-existing emissions reporting environment. Existing emissions reporting infrastructure may not align with the CBAM's product-level measurement and verification requirements and not reduce CBAM reporting costs. If adapting existing infrastructure or developing new infrastructure is costly relative to any expected benefits, even firms with existing infrastructure or relatively low reporting complexity may exhibit little change. Conversely, if the incremental cost of CBAM reporting is modest, suppliers may respond similarly regardless of existing emissions reporting infrastructure or reporting complexity. These considerations make the existence and cross-sectional distribution of CBAM-induced decarbonization and disclosure responses uncertain.

Our empirical analysis uses a global sample of non-EU firms. We use detailed product-level export data to identify non-EU firms producing and exporting CBAM Products. We define our treatment group as non-EU suppliers that exported at least one CBAM Product during the pre-CBAM period (CBAM Exporters), thereby demonstrating both the capacity to produce these goods and an active trade relationship with importers outside of the country. We construct a control group of firms that did not export any CBAM Products in the pre-period, but that are from the same countries and industries as the treated firms. We focus on emissions intensity (emissions scaled by revenue) to control for potentially confounding changes in production volume and better isolate changes in emissions abatement (e.g., Aswani et al., 2024). We analyze measures that aggregate Scope 1 and Scope 2 emissions in addition to examining each scope separately.[5] Our final sample includes 2,664 unique firms across 20 industries and 12 countries.

We find that CBAM Exporters exhibit significantly lower emissions intensity following the passage of the CBAM relative to the control group and that effects increase with greater pre-CBAM supply chain relationships with EU Importers. The magnitude of the documented effect is economically meaningful: treated firms reduce total Scope 1 and Scope 2 emissions intensity by approximately 9.8 percent more than control firms. A dynamic event-study analysis indicates that treatment and control firms followed similar trends in emissions intensity in the years preceding the CBAM, but their trajectories diverged afterward.

Next, we examine how firms' pre-CBAM emissions reporting environments shape their responses to the CBAM. We use prior sustainability disclosure as an observable proxy for pre-existing emissions information infrastructure. Firms that disclosed emissions before the CBAM are more likely to have already invested in the systems, processes, and expertise needed to measure and communicate emissions, thereby reducing the incremental cost of satisfying the regulation's reporting requirements. We find that post-CBAM declines in emissions intensity are higher among CBAM Exporters with pre-CBAM emissions disclosure, consistent with pre-existing emissions

[5] In our primary analyses we do not include upstream Scope 3 emissions for three reasons (1) we expect Scope 1 and Scope 2 emissions to capture the majority of emissions covered by the CBAM embedded emission calculations, (2) we are unable to distinguish between Scope 3 emissions related vs. unrelated to CBAM Products used as inputs to complex goods, and (3) the measurement of scope 3 emissions is challenging and a contentious issue (e.g. Condon, 2023; Ducoulombier, 2021). In additional analyses we separately explore potential abatement of Scope 3 emissions.

information infrastructure reducing the incremental cost of responding to the CBAM.[6]

To examine the impact of variation in reporting complexity we use the breadth of CBAM Products exported by the firm. A broader product portfolio likely increases reporting complexity by requiring firms not only to perform more product-level calculations, but also to disentangle and allocate emissions from shared machinery, production processes, and energy inputs across products. We find evidence that CBAM Exporters with relatively narrower product scope reduce total emissions intensity following the CBAM more than firms with a broader product scope. Importantly, this difference is concentrated among firms without pre-CBAM emissions disclosure, consistent with reporting complexity constraining decarbonization to a greater extent when firms have not already developed emissions information infrastructure.

We also consider whether responses vary with firms' relative pre-CBAM emissions intensity. Because the default values used when information is unavailable are based on benchmarks rather than firms' actual emissions, CBAM Exporters with relatively lower emissions intensity may benefit more from providing emissions data, whereas default values may be less punitive or even beneficial for higher intensity firms. Consistent with this intuition, we find that reductions in emissions intensity are concentrated among CBAM Exporters with relatively lower pre-CBAM emissions intensity.

Turning to disclosure, we examine whether the CBAM changes foreign suppliers' emissions-disclosure behavior. Focusing on firms that did not disclose emissions before the regulation, we test whether CBAM Exporters are more likely than control firms to initiate disclosure following the CBAM. We find that CBAM Exporters initiate emissions disclosure at a significantly higher

[6] We caution that the magnitude of differences in these tests should be interpreted carefully as we cannot eliminate the possibility that differential measurement precision in emissions across the two partitions may contribute to the observed heterogeneity. We discuss this issue and the steps taken to address it in detail in Section 4.2.

rate, consistent with the regulation increasing suppliers' incentives to produce and communicate emissions information. This disclosure response is stronger among firms with greater exposure to EU Importers and is concentrated among disclosure events in which reported emissions fall below a proxy for the default-value benchmark.

To understand whether the effects we document extend beyond CBAM Exporters' emissions intensity, we also explore broader implications of the CBAM. First, we re-estimate our main analyses using absolute emissions rather than emissions intensity. We find results consistent with declines having occurred not only in the intensity of CBAM Exporters emissions, but also in their overall emissions levels. Second, we examine non-EU suppliers' upstream Scope 3 emissions and find some evidence of decarbonization effects extending a further step upstream to the CBAM Exporters' suppliers.[7]

With these findings, our paper contributes to a growing literature examining the effects of carbon pricing (e.g., Andersson 2019; Bolton and Kacperczyk 2021; Li et al. 2021; Pretis 2022; Metcalf and Stock 2023; Bolton et al. 2023; Dang et al. 2023; Känzig 2023; Ivanov et al. 2024; Martinsson et al. 2024) and more specifically, the effects of a BCA (Fowlie et al. 2021; Bellora and Fontagné 2023; Fontagné and Schubert 2023; Clora et al. 2023; Cho et al. 2024; Alonso et al. 2025). We extend this literature by showing not only decarbonization effects following treatment by a BCA, but also the impact pre-BCA emissions reporting environment has on foreign suppliers' emissions abatement. Our evidence of divergent abatement outcomes with existing emissions reporting infrastructure and reporting complexity identifies previously unexamined sources of heterogeneity in BCA effectiveness.

[7] Certain upstream Scope 3 emissions are included in the calculation of imbedded emissions for complex goods creating potential incentives that extend beyond CBAM Exporters to their suppliers. Additionally, increased use of cleaner energy sources (reflected in Scope 2 emissions intensity reductions) may also have the benefit of lower overall lifecycle emissions, which could also be captured in Scope 3 upstream reductions.

Our findings also contribute to the growing literature on sustainability disclosure. Prior work on regulating sustainability reporting generally finds positive real effects around the regulated information disclosure (e.g., Christensen et al., 2017; Chen et al., 2018; Downar et al., 2021; Fiechter et al., 2022; Tomar, 2023; Krueger et al., 2024). Prior work also shows strict monitoring and verification of disclosure generally improve real outcomes from sustainability regulation (Duflo et al. 2013; He et al. 2020; Gipper et al. 2025). We extend this literature by identifying an interdependency between abatement and information production that shapes responses to a BCA.

Finally, we contribute to research on the propagation of sustainability incentives through supply chains. Prior research shows that downstream firms can influence upstream environmental disclosure and performance through contracting, monitoring, and disclosure requirements (Schiller 2018; Dai et al. 2021; Darendeli et al. 2022; She 2022; Wang, 2023; Bonetti et al. 2024). Because we examine a regulatory structure in which compliance depends on the emissions reporting of firms outside the regulator's jurisdiction, the CBAM represents a novel extension of prior research. We provide new evidence on how sustainability regulation propagates across international supply chains and how pre-regulation emissions reporting environments impact the incentives created for upstream firms by downstream regulation.

Our results should be of interest to regulators, market participants, and other stakeholders in working towards a globally integrated carbon pricing system. We highlight the importance of improving reporting and verification for high emissions firms globally and reinforce the EU's efforts to collaborate with other countries to develop more carbon pricing systems (with regulated reporting and verification).[8] Our paper also informs the worldwide debate around the costs and

[8] For example, according to the Financial Times, the European Commission's international carbon pricing task force has collaborated with more than 40 countries to push for greater carbon pricing globally and to help with the development of new mechanisms like ETS. (Hancock and Mundy, 2025).

benefits of BCAs. Some jurisdictions already have plans to implement their own BCA or are engaged in feasibility analyses related to the topic while other countries are considering or have already pursued legal action to prevent the propagation of such mechanisms.[9]

2. Institutional Background and Expected Foreign Supplier Responses to the CBAM

2.1 The CBAM and Non-EU Exporters of CBAM Products

The EU Carbon Border Adjustment Mechanism (CBAM) is the world's first large-scale border carbon adjustment. Although the regulation legally targets EU-based importers of carbon-intensive goods ("EU Importers"), it is expected to have substantial indirect effects on non-EU firms that supply those goods ("CBAM Exporters"). The CBAM is designed to mitigate carbon leakage and create a level playing field within the EU by ensuring that imported goods bear a carbon cost comparable to the cost of carbon paid by producers in the EU covered by the EU ETS. Initially, the CBAM applies to goods in six emissions-intensive sectors identified as having the greatest leakage risk: iron and steel, aluminum, cement, fertilizers, hydrogen, and electricity generation. Below, we summarize the features most relevant to CBAM Exporters.[10]

Under the CBAM, EU Importers must submit quarterly emissions reports for covered products ("CBAM Products," listed in Appendix B) and buy CBAM certificates to cover the embedded emissions of those imports. The CBAM reporting and verification requirements mirror the architecture of the EU ETS, reflecting over two decades of regulatory learning and investment in emissions-measurement infrastructure. The CBAM entered a transitional "report-only" phase on October 1, 2023, during which EU importers must report embedded emissions but were not yet

[9] Some non-EU jurisdictions have publicly announced plans to develop carbon-border adjustment mechanisms, while others have signaled or initiated legal or WTO-related challenges to the CBAM. For example, the UK and Norway have committed to national CBAMs by 2027, and organizations such as IETA classify Australia among countries "developing carbon-border levies." At the same time, India, South Africa, Brazil, China, and Russia have voiced opposition — describing CBAM as protectionist or discriminatory — and several have signaled or taken steps toward WTO complaints or other legal challenges.

[10] For a more comprehensive description of the CBAM, see Alonso et al. (2026).

required to obtain verification and purchase CBAM certificates. On January 1, 2026, the CBAM entered its definitive phase, under which authorized declarants must satisfy reporting obligations and purchase and surrender CBAM certificates corresponding to embedded emissions. Because the CBAM certificate price is tied to the weekly average EU ETS allowance price, CBAM Exporters indirectly face the same carbon price signal as EU based producers when selling CBAM Products to EU Importers.

Although EU Importers hold the formal compliance obligation, their ability to meet the CBAM reporting and verification requirements depends critically on the willingness and capability of CBAM Exporters to measure, document, verify and communicate the embedded emissions of the goods they export. CBAM Exporters are outside of the regulation and any response they make to the CBAM is a choice, not a mandate. When a supplier does not provide emissions information that satisfies the applicable methodological and verification requirements, the EU Importer may use prescribed default values that are conservatively determined and include an applicable mark-up. The design reduces the likelihood that withholding actual emissions confers a systematic advantage, limiting potential benefits from intentional non-disclosure of embedded emissions.[11]

Embedded emissions must be calculated at the product level, and the CBAM distinguishes between "simple" and "complex" goods for determining the boundaries of the calculation. For simple goods—those produced without using other CBAM Products as inputs—embedded emissions include (i) direct emissions generated during the production process, including emissions from the production of heating and cooling even if produced off-site, and (ii) indirect

[11] According to Regulation (EU) 2023/956, Article 7: default values "shall be set at the average emission intensity of each exporting country, increased by a proportionately designed mark-up." Contemporary regulatory and professional guidance generally emphasized that default values would be conservative but did not identify expected percentages. Implementing legislation adopted in December 2025 subsequently established mark-ups of generally 10 percent in 2026, 20 percent in 2027, and 30 percent from 2028 onward.

emissions associated with the electricity consumed in manufacturing. For complex goods that incorporate CBAM Products as inputs, suppliers must also include the direct and indirect embedded emissions of those CBAM Product inputs. As a result, CBAM Exporters may need to measure emissions associated not only with their own production processes but also, where applicable, with upstream CBAM-covered inputs embedded in the final product.

In practice, this means CBAM Exporters seeking to support the use of actual emissions values need to provide product-level data on Scope 1 emissions, Scope 2 emissions, and in less frequent cases certain upstream Scope 3 emissions. Embedded emissions are generally calculated using data from the production period preceding importation, typically the supplier's prior calendar year, with data from two years earlier permitted when more recent information is unavailable

Producing emissions information that satisfies the CBAM requirements can require substantial investments in systems, processes, and expertise. Firms must identify the relevant production boundaries, collect activity and emissions data at the installation level, attribute shared fuel, electricity, equipment, and process emissions across individual products, and incorporate emissions associated with covered precursor inputs where applicable. These calculations may require information from multiple facilities, business units, utilities, and upstream suppliers, as well as the development of consistent allocation methodologies, monitoring plans, documentation, and internal controls. Firms must also communicate the resulting information to EU Importers in a form that can support their CBAM declarations and withstand independent verification during the definitive stage. The burden is likely to be particularly high for firms with limited pre-existing emissions information infrastructure or broad portfolios of CBAM Products produced through overlapping processes, because such firms must both develop new measurement capabilities and perform a larger and potentially more complex set of product-level calculations.[12]

By the end of 2022, the EU Parliament had reached a provisional agreement with the EU Council and the European Commission on the draft text of the CBAM, providing market participants with substantial clarity regarding the regulation's structure, product coverage, reporting requirements, and implementation timeline. EU Importers could therefore begin evaluating suppliers' emissions profiles, requesting additional information, revising procurement practices, and considering supply-chain adjustments as early as 2023.

2.2 Foreign Supplier Responses to the CBAM

CBAM Exporters operate outside the EU's (and hence the CBAM's) regulatory jurisdiction but may nevertheless face a carbon-price incentive from the CBAM through their relationships with EU Importers. Reducing the embedded emissions of CBAM Products can lower the CBAM certificate costs associated with importing those products to the EU and improve a supplier's competitiveness relative to higher-emissions suppliers or substitute products. These incentives should be stronger when exporters have greater commercial exposure to the EU and when importers can transmit carbon costs or decarbonization pressure upstream through pricing, sourcing decisions, or the threat of switching suppliers. Accordingly, we expect CBAM Exporters to reduce emissions following the introduction of the CBAM.

Unlike domestic carbon-pricing regimes, however, the CBAM separates formal compliance responsibility from control over the emissions-generating activities and much of the information needed for compliance. EU Importers are responsible for reporting embedded emissions and for

[12] The European Commission's guidance for non-EU installation operators describes requirements related to defining production-process boundaries, preparing monitoring documentation, selecting data sources, implementing control procedures, allocating emissions across production processes, and monitoring emissions embedded in precursor inputs. The definitive-period methodology subsequently formalized these and related requirements. See European Commission Guidance Document on CBAM Implementation for Installation Operations Outside the EU, December 8, 2023, and Commission Implementing Regulation (EU) 2025/2547, December 10, 2025.

purchasing CBAM certificates to cover those emissions, whereas CBAM Exporters control the operations that generate the priced emissions and the reporting infrastructure needed to calculate embedded emissions. As a result, the economic return to abatement is not only a function of emissions reduction but also depends on the CBAM Exporters' ability to measure, document, verify, and communicate emissions performance. If a supplier lowers emissions intensity but cannot provide information satisfying the CBAM's methodological and verification requirements, the importer may continue to rely on prescribed default values and the reduction may not translate into lower CBAM-related carbon costs. Emissions abatement and emissions information production are therefore complementary responses to the regulation.

This complementarity implies that the cost of producing compliant information can shape suppliers' incentives to decarbonize. Firms that have already invested in data systems, measurement processes, personnel, expertise, documentation, and internal controls should face lower incremental cost of producing CBAM relevant information. By contrast, firms without such infrastructure may need to incur both the cost of abatement and the additional cost of developing the systems needed to demonstrate it. We therefore expect reductions in emissions after the CBAM to be stronger among CBAM Exporters with greater existing emissions information infrastructure.

The cost of producing CBAM relevant information should also vary with the complexity of the required product-level calculations. For example, firms exporting a broader portfolio of CBAM Products need to calculate embedded emissions for more product types and potentially allocate emissions from shared machinery, production processes, and energy inputs across products that differ in their use of shared resources. This increases both the number and complexity of the calculations needed to support CBAM reporting. Accordingly, we expect CBAM-induced decarbonization to be weaker among firms with greater reporting complexity, particularly when the firm lacks existing emissions information infrastructure. Conversely, pre-existing emissions information infrastructure may mitigate incremental costs associated with reporting complexity because required systems, processes, and capabilities may already be in place.

We also expect the CBAM to change suppliers' incentives to produce and disclose emissions information. Firms that did not previously disclose emissions may invest in emissions measurement and reporting systems to support continued access to EU customers, communicate lower embedded emissions, and reduce reliance on default values. These investments may also increase the likelihood that firms begin publicly disclosing emissions. We therefore expect CBAM Exporters that did not disclose emissions before the regulation to initiate emissions disclosure at a higher rate after the CBAM than comparable control firms. This response should be stronger when exposure to EU Importers is greater because the commercial value of producing and communicating credible emissions information is higher.

The expected value of reporting actual emissions may also differ across CBAM Exporters. Prescribed default values are based on benchmark emissions rather than each firm's actual performance. CBAM Exporters with relatively lower emissions intensity may therefore benefit more from demonstrating their actual emissions. In contrast, default values may be less punitive and, in some cases, even potentially advantageous for CBAM Exporters with higher emissions intensity. This difference may affect both the incentive to report emissions and, because the return to abatement depends on communicating lower emissions, the incentive to decarbonize. Accordingly, we expect CBAM-induced decarbonization and disclosure responses to be stronger among suppliers with relatively lower pre-CBAM emissions intensity.

Despite these theoretical predictions, several features of the CBAM make the expected magnitude and distribution of effects unclear ex ante. First, the policy depends on EU importers' ability to pass carbon costs upstream or otherwise exert meaningful pressure on non-EU suppliers, for example through pricing, contracting, or the threat of switching suppliers or products. The extent to which EU importers can do this is unclear, with prior work suggesting investors expect EU firms to disproportionately bear the costs of the CBAM (Alonso et al. 2026). Second, because the CBAM certificate price is anchored to EU ETS allowance prices, it reflects abatement costs and market conditions within the EU, not those faced by CBAM Exporters. The carbon price may therefore be misaligned with foreign suppliers' marginal abatement cost curves, reducing the likelihood of a meaningful response. Third, the initial "report-only" phase of the CBAM (2023–2025) may delay both abatement and reporting responses as firms await greater regulatory certainty and the onset of payments for embedded emissions before undertaking costly operational or reporting infrastructure changes.

Further, even if incentives are transmitted, suppliers' responses may not vary systematically with their pre-existing emissions reporting environment. Existing emissions reporting infrastructure may not align with the CBAM's product-level measurement and verification requirements and not reduce CBAM reporting costs. If adapting existing infrastructure or developing new infrastructure is costly relative to any expected benefits, even firms with existing infrastructure or relatively low reporting complexity may exhibit little change. Conversely, if the incremental cost of CBAM reporting is modest, suppliers may respond similarly regardless of existing emissions reporting infrastructure or reporting complexity. Thus, the presence, magnitude, and cross-sectional variation of CBAM-induced abatement and disclosure effects on CBAM Exporters are important empirical questions.

3. Research Design

3.1 Sample Selection

We begin with the universe of firms covered by the Trucost Environmental database ("Trucost") for the years 2018 to 2025. We restrict the sample to publicly traded firms to facilitate linking with product level export information from the Panjiva Supply Chain Intelligence database ("Panjiva"). We exclude transportation, distribution, and trading firms because they generally act as intermediaries between exporters and importers, and their reported emissions primarily reflect transportation operations rather than the embedded emissions of the goods transported.[13] We also drop all firms located in countries that Panjiva does not provide export records for, as we are unable to accurately identify which firms in those jurisdictions export CBAM Products. We exclude firms whose disclosure classification changes during the pre-CBAM period because such firms cannot be assigned unambiguously to the pre-existing-disclosure and nondisclosure groups used in our cross-sectional analyses. Finally, we retain industries in which at least 10 percent of firms export CBAM Products and CBAM Products account for at least 1 percent of firms' exports on average. This restriction focuses the analysis on industries with economically meaningful CBAM exposure and limits the influence of industries with isolated or atypical exporters of CBAM Products.

3.2 Treatment and Control Groups

We define the treatment group ("CBAM Exporters") as non-EU suppliers that exported at least one CBAM-covered product during the pre-CBAM period. Specifically, we define *CBAM Exporter* as an indicator variable that equals one if a non-EU supplier exported any of the CBAM

[13] Specifically, we drop firms categorized in the Trucost industries: Air Freight and Logistics, Distributors, Ground Transportation, Marine Transportation, and Trading Companies and Distributors. According to the GHG Protocol, a transportation provider should not include emissions associated with the production of goods being transported in its emissions. Instead, those emissions should be reported in the Scope 3 emissions of the purchaser of the goods.

Products listed in Appendix B in 2022, the year prior to the passage of the CBAM.[14] These firms demonstrate both the capacity to produce CBAM Products and participation in international markets through which CBAM-related pressure could be transmitted. Although this measure does not require us to observe a direct shipment to an EU purchaser, firms exporting covered products before the CBAM are more likely to be exposed to importer requests for emissions information and pressure to reduce embedded emissions.[15] We construct a control group of non-EU suppliers that did not export any CBAM Products in the pre-period, selected from the same countries and industries as the CBAM Exporters to improve comparability.

3.3 Post-CBAM Period

On June 22, 2022, the European Parliament adopted its formal position on the CBAM regulation and released a draft framework specifying the products covered, the methodology for calculating embedded emissions, the associated reporting and verification requirements, and the expected implementation timeline. By the end of 2022, the EU Parliament had reached a provisional agreement with the EU Council and the European Commission on the draft text of the CBAM, resolving substantial uncertainty regarding the regulation's core design. The CBAM was formally adopted in April 2023.

We expect CBAM-related incentives for non-EU suppliers to begin in 2023. Once the policy's principal features became sufficiently clear, EU Importers could begin evaluating suppliers' emissions profiles, requesting additional information, and considering procurement or supply-

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[14] China ceased providing export records to Panjiva after 2018. We therefore classify Chinese firms using their 2018 export activity. Because this potentially introduces greater measurement error into the treatment classification, we re-estimate our primary analyses excluding Chinese firms. Inferences are unchanged (see Table OA1).

[15] Two features of the Panjiva data limit our ability to implement a more direct treatment definition identifying non-EU suppliers that exported CBAM-covered products specifically to EU-based purchasers. First, Panjiva does not consistently identify the ultimate purchaser or final shipment destination, particularly when goods pass through intermediaries or are repackaged at interim destinations. Second, EU customs authorities do not provide importer-side records to Panjiva, limiting our ability to validate EU destinations using corresponding import data. In cross-sectional analyses, however, we can show that effects increase with observable supply-chain exposure to EU Importers.

chain adjustments. These incentives are reinforced by the reliance on historical data to calculate embedded emissions. As described in Section 2.1, embedded emissions are generally calculated using data from the production period preceding importation, typically the supplier's prior calendar year, with data from two years earlier permitted when more recent information is unavailable. This means CBAM Exporters likely faced incentives to begin aligning their reporting and verification systems with CBAM methodologies during 2023 in order to satisfy reporting requirements for exports to the EU occurring in 2024 and 2025. Accordingly, we define *Post* as an indicator equal to one for firm-year observations in 2023 and later.

3.4 Pre-CBAM Emissions Information Infrastructure

We use pre-CBAM emissions disclosure as an observable proxy for suppliers' pre-existing emissions information infrastructure. Specifically, we use Trucost's *Weighted Contribution: GHG Disclosure* variable, which measures the proportion of a company's estimated Scope 1 greenhouse gas (GHG) emissions that are based on company-disclosed rather than Trucost-modelled data.[16] We use the 2022 value of this variable and define *Pre_Disclosure* as an indicator equal to one for firms with non-zero values of *Weighted Contribution: GHG Disclosure*. Firms that disclosed emissions before the CBAM are more likely to have invested in data systems, measurement processes, personnel, expertise, documentation, and internal controls that can reduce the incremental cost of producing CBAM-relevant information.

This proxy reflects the extent of publicly disclosed emissions, providing a signal about firms' underlying emissions information infrastructure. However, it should be interpreted carefully; some firms may maintain robust emissions information infrastructure but withhold disclosure for strategic, competitive, litigation, or other reasons. Additionally, the measure is constructed from

[16] Emissions are external cost weighted using Trucost's proprietary environmental damage-cost methodology.

firm-level disclosures and may not generalize to the product-level, installation-specific reporting required under the CBAM. Finally, the underlying Trucost variable captures only the share of emissions disclosed and not the accuracy or quality of the emissions information, which are also important elements of existing emissions information infrastructure.

3.5 Pre-CBAM Reporting Complexity

We use the breadth of firms' CBAM-covered product portfolios as a proxy for reporting complexity. Specifically, we calculate *#CBAMCodes* equal to the number of distinct CBAM product codes exported by a CBAM Exporter from the Panjiva database. Firms exporting a broader range of CBAM Products may need to perform more product-level emissions calculations and allocate emissions from shared machinery, production processes, and energy inputs across products that differ in processing stage and resource intensity. We classify CBAM Exporters as having narrow or broad product breadth based on whether their number of distinct CBAM codes falls below or above the treatment-sample median.

3.6 Sample Composition and Descriptive Statistics

As shown in Table 1, our sample selection procedure results in 16,252 firm-year observations for 2,664 unique firms from 12 non-EU countries and 20 industries. We note that the largest shares of our sample are from China (57 percent), the United States (24 percent), and India (12 percent). In terms of industry concentration, we see wide dispersion with the largest industry groups (Chemicals and Machinery) accounting for 13 and 12 percent of the sample respectively. Approximately 14 percent of our final sample of non-EU suppliers are CBAM Exporters. Table 2 provides descriptive statistics of the variables used in our tests. The average non-EU supplier in our sample has approximately 0.9 million tons of CO_2 equivalent Scope 1 and Scope 2 GHG emissions per year during the sample period with an average emissions intensity of 339 tons of

CO_2 equivalent per million dollars of revenue, highlighting the materiality of emissions for firms operating in industries where CBAM Products are produced. The distributions of firm-level emission measures are strongly right-skewed, so we use the logarithmic transformation of these measures. Approximately 21 percent of the sample firms provided disclosure of emissions in the year preceding the passage of the CBAM. The average (median) number of distinct CBAM products exported by CBAM Exporters before the CBAM was 5 (3).

4. CBAM Exposure and Foreign Supplier Decarbonization

4.1 Average Decarbonization Effects

Our first set of analyses examines whether exposure to the CBAM is associated with changes in emissions intensity. We estimate the following difference-in-differences model, which compares changes in emissions intensity for CBAM Exporters relative to control firms before and after the introduction of the CBAM:

$$EmissionsIntensity_{it} = \beta\, CBAM\ Exporter_i \times Post + \delta_i + \phi_t + \varepsilon_{it} \qquad (1)$$

The main coefficient of interest is β_1 where we expect a negative coefficient consistent with CBAM Exporters decarbonizing after the CBAM. *CBAM Exporter* is an indicator variable that equals one if the firm exported at least one CBAM-covered product during the pre-CBAM period and *Post* is an indicator variable that equals one if the year is 2023 or later (See Sections 3.2 and 3.3 for detailed discussions of each variable). δ_i and ϕ_t represent firm and year fixed effects, respectively. This fixed-effects structure controls for time invariant characteristics of individual firms as well as changes in market or other conditions across time that affect all firms (e.g., increases in oil and gas prices). We intentionally do not include additional time-varying firm-level controls such as revenue, profitability, leverage, liquidity, or growth because these variables may themselves be affected by investments in emissions information infrastructure, reporting, and abatement (Dai et al. 2025). Including such controls could absorb economically meaningful components of the treatment response and obscure the total effect of the CBAM. We cluster standard errors by firm.

To capture changes in emissions performance aligned with the emissions coverage of the CBAM we consider three separate measures of non-EU suppliers *EmissionsIntensity*. We use the natural log of Trucost's: (i) Scope 1 plus Scope 2 GHG emissions intensity (*GHGIntensity1&2),* (ii) Scope 1 GHG emissions intensity (*GHGIntensity1*); and (iii) Scope 2 GHG emissions intensity *(GHG Intensity 2)*.

As shown in Table 3, Panel A, the emissions intensity of CBAM Exporters is relatively lower after the passage of the CBAM compared to that of control firms. In terms of *GHG Intensity 1&2*, the estimated magnitude of β suggests a relative decrease of 9.8 percent compared to control firms. In Panel B we note that effects are generally increasing with higher observable supply chain relationships with EU Importers. When examining emissions components separately, we see the reduction is more pronounced for Scope 2 emissions intensity, while changes in Scope 1 emissions intensity are generally smaller and only statistically significant for CBAM Exporters with the highest observed relationship with EU Importers. One plausible explanation for this difference is that CBAM-covered products typically rely on capital and process intensive manufacturing technologies that are costly to modify in the short run, whereas reducing the carbon intensity of purchased electricity offers a more immediate pathway for abatement.

We also estimate a dynamic version of equation (1), that interacts treatment status with year-specific indicators, using 2022 as the reference year. Figure 1 plots the resulting coefficients and associated 95 percent confidence intervals. We find no discernible differences in patterns in the pre-period for CBAM Exporters relative to our control group, consistent with the treated and control firms experiencing similar (parallel) trends before the CBAM. Following the introduction of the CBAM, however, emissions intensity declines more sharply for CBAM Exporters, with the most immediate effects observed for Scope 2 emissions intensity and a more gradual but increasing trend of declines for Scope 1.

4.2 Pre-existing Emissions Information Infrastructure

We next examine whether the decarbonization response varies with firms' pre-existing emissions information infrastructure. As discussed in Section 3.4, we use pre-CBAM emissions disclosure as a proxy for firms' pre-existing emissions-information infrastructure. We re-estimate Equation (1) separately for firms that disclosed emissions prior to the CBAM and for firms that did not disclose emissions.

Table 4 shows that, among firms with pre-CBAM emissions disclosure, CBAM Exporters reduce *GHGIntensity1&2* by approximately 16.1 percent relative to control firms following the introduction of the CBAM. In contrast, we find no significant reduction among firms without pre-CBAM disclosure. Formal tests comparing the *CBAM Exporter* × *Post* coefficients across the two samples indicate that the differences are statistically significant for *GHGIntensity1&2* and *GHGIntensity2*. These findings are consistent with pre-existing emissions-information infrastructure reducing the incremental cost of measuring, documenting, and communicating the benefits of abatement, thereby facilitating a stronger decarbonization response to the CBAM.

Figures 2 and 3 repeat the dynamic analysis separately for firms with and without pre-CBAM disclosure. In both partitions we find no discernible differences in patterns in the pre-period for CBAM Exporters relative to our control group. Following the introduction of the CBAM, all three measures of emissions intensity decline more sharply for CBAM Exporters with pre-CBAM emissions disclosure than control firms.[17] In contrast, among firms without pre-CBAM disclosure, we do not see evidence of post CBAM reductions in *GHGIntensity1&2* and *GHGIntensity2*, although we do see some evidence of an increasing decarbonization trend for *GHGIntensity1*.

4.3 Reporting Complexity

We next examine whether the decarbonization response varies with the complexity of producing product-level emissions information under the CBAM. As discussed in Section 3.5, we use the breadth of firms' pre-CBAM portfolios of CBAM-covered products as a proxy for reporting complexity. We define *Narrower CBAM Exporter* (*Broader CBAM Exporter)* as an indicator variable that equals one if the number of distinct CBAM product codes exported by a firm before the CBAM falls below (above) the treatment-sample median. We then modify equation (1) as follows.

$$\begin{aligned} EmissionsIntensity_{it} = \;& \beta_1\, Narrower\ CBAM\ Exporter_i \times Post \\ & + \beta_2\, Broader\ CBAM\ Exporter_i \times Post + \delta_i + \phi_t + \varepsilon_{it} \qquad (2) \end{aligned}$$

Columns 1 to 3 of Table 5 present the results of estimating equation (2) to examine whether the decarbonization response differs between narrower and broader scope CBAM Exporters. The estimated coefficient on *Narrower CBAM Exporter* × *Post* is negative and statistically significant across all three emissions-intensity measures. By contrast, the coefficient on *Broader CBAM Exporter* × *Post* is smaller and only significant for *GHGIntensity2.* Formal tests indicate that the

[17] We assess the robustness of the parallel trends assumption using the approach of Rambachan and Roth (2023). We allow post-period deviations from parallel trends to range from 0 to 0.5 of the largest pre-period deviation. In untabulated tests, the 95% confidence intervals for the estimated reduction in *GHG Intensity 2* in the full sample exclude 0 when post-period deviations are no greater than 10% of the largest pre-period deviation, but begin to include 0 when such deviations reach 20%. Among firms with pre-CBAM emissions disclosure, the 95% confidence intervals for the estimated reductions in *GHG Intensity 1&2* and *GHG Intensity 2* exclude 0 when post-period deviations are no greater than 20% of the largest pre-period deviation. For *GHG Intensity 1*, the confidence interval begins to include 0 when post-period deviations reach 10% of the largest pre-period deviation. These results indicate that the estimated effects are robust to small deviations from parallel trends, with comparatively greater robustness among firms with pre-CBAM emissions disclosure.

estimated reductions differ significantly between narrower and broader scope exporters for *GHGIntensity1&2* and *GHGIntensity1*. Collectively, we interpret these results as consistent with greater reporting complexity constraining CBAM Exporters' decarbonization response.

We next examine whether pre-existing emissions information infrastructure mitigates the reporting burden associated with broader product scope. We add interaction terms with *Disclosure_Pre* to Equation (2) and re-estimate the revised equation in Columns 4 to 6 of Table 5. We find that the difference between narrower and broader scope CBAM Exporters is concentrated among firms without pre-CBAM emissions disclosure. Within this group, narrower scope CBAM Exporters experience significantly greater reductions in *GHGIntensity1&2* and *GHGIntensity1* than broader scope CBAM Exporters. In contrast, among firms with pre-CBAM disclosure, the estimated decarbonization responses do not differ significantly between narrower and broader scope CBAM Exporters. This pattern is consistent with pre-existing emissions information infrastructure mitigating the incremental burden of reporting complexity.[18]

4.4 Relative Emissions Performance and Default-Value Incentives

We next examine whether the decarbonization response varies with CBAM Exporters' relative emissions performance before the regulation. As discussed in Section 2.2, suppliers whose actual emissions compare favorably with prescribed default values may have more to gain from measuring and communicating their emissions performance. We define *LEmissions CBAM Exporter* (*HEmissions CBAM Exporter)* as an indicator variable that equals one if the firm's pre-CBAM *GHGIntensity1&2* is below (above) 1.1 times the average *GHGIntensity1&2* for *CBAM*

[18] We address concerns that the observed differences in decarbonization for firms with vs. without pre-CBAM emissions disclosure could at least partially relate to differences in precision of Trucost emissions measures for firms that disclose emissions compared to for firms whose emissions are primarily modeled in Section 6.2.

Exporters from the same country in 2022.[19] We then modify equation (1) as follows.

$$EmissionsIntensity_{it} = \beta_1 \, LEmissions\ CBAM\ Exporter_i \times Post + \beta_2 \, HEmissions\ CBAM\ Exporter_i \times Post + \delta_i + \phi_t + \varepsilon_{it} \quad (3)$$

Table 6 shows that the estimated decarbonization response is concentrated among CBAM Exporters with relatively lower pre-CBAM emissions intensity. In Panel A, the coefficient on *LEmissions CBAM Exporter* × *Post* is negative and statistically significant across all specifications, whereas the coefficient on *HEmissions CBAM Exporter* × *Post* is small and statistically insignificant. The difference between the two coefficients becomes statistically significant when the sample is restricted to firms with pre-CBAM emissions disclosure, including the further restriction to narrower-scope exporters. The results for Scope 1 emissions intensity in Panel B are similar and provide the strongest evidence of differences between lower- and higher-intensity exporters. In Panel C, both groups exhibit negative estimates for Scope 2 emissions intensity, and the differences between the groups are not statistically significant.

The results are consistent with decarbonization responses being stronger when actual emissions information compares favorably with the default-value benchmark. The concentration of the differences in samples with pre-existing emissions disclosure and narrower product scope is also consistent with that potential benefit being easier to realize when firms are more likely to have existing emissions information infrastructure and less complex reporting environments.

5. CBAM Exposure and Emissions Disclosure

5.1 Probability and Timing of Disclosure Initiation

We next examine whether the CBAM induces previously non-disclosing foreign suppliers to

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[19] As discussed in Section 2.1, default values used when compliant actual emissions data is not available are set at the average emission intensity of the exporting country increased by a mark-up. Implementing legislation established mark-ups generally equal to 10 percent in 2026 providing the basis for our use of 1.1x.

begin disclosing emissions information. The analyses are limited to firms without pre-CBAM emissions disclosure and to the post periods of our sample.

We start by examining the probability that firms initiate disclosure in any year after 2022. We collapse the sample to one observation per firm and define *Disclosure Post* as an indicator variable equal to one if a firm with *Disclosure Pre* = 0 subsequently reported a non-zero value of *GHG Disclosure*. We estimate the following linear probability model:

$$\begin{aligned} Disclosure\ Post_i = \quad & \beta_1\, CBAM\ Exporter_i + \beta_2\, CBAM\ Exporter_i \times EU_i \\ & + \Phi\, Controls_i + \alpha_c + \chi_n + \varepsilon_i \end{aligned} \tag{4}$$

The coefficients of interest are β_1 and β_2. We expect CBAM Exporters to be more likely than control firms to initiate disclosure during the post-CBAM period, with a stronger association among exporters with observable pre-CBAM supply-chain relationships with EU Importers. *EU* is an indicator variable that equals one if a CBAM Exporter has observable pre-CBAM supply-chain relationships with EU Importers (*EUCBAM% > 0).* The terms $\alpha_c + \chi_n$ represent country and industry fixed effects, respectively. Because the model does not include firm fixed effects, we also control for Pre-CBAM firm characteristics prior research has found to be associated with firm disclosure decisions.

Table 7 shows that CBAM Exporters are significantly more likely than control firms to initiate emissions disclosure following the introduction of the CBAM. In Column 1, the coefficient on *CBAM Exporter* is consistent with a 24.7 percentage point higher probability of disclosure initiation. After controlling for pre-CBAM firm characteristics in Column 3, the estimated difference remains statistically significant at 13.2 percentage points. Columns 2 and 4 further show that disclosure initiation is stronger among CBAM Exporters with observable pre-CBAM supply-chain relationships with EU Importers.

Table 8 complements this analysis by maintaining the firm-year time series information from the 2022 baseline through the end of our sample and estimating Cox proportional hazards models. This approach incorporates both the timing of disclosure initiation and information for firms that remain non-disclosers through the end of the sample period. We start by classifying events as the first time we observe non-zero values of *GHG Disclosure* in the post period for firms with *Disclosure Pre* = 0. The models include the same pre-CBAM control variables used in Table 7 and are stratified by country and industry.

In Column 1 of Table 8, the hazard ratio on CBAM Exporter is 1.502, indicating that CBAM Exporters have a 50.2 percent higher conditional rate of initiating disclosure than control firms. In Column 2, when we allow the response to vary with observable EU relationships, we again find that effects are stronger when suppliers are more directly exposed to EU customers. Taken together, Tables 7 and 8 provide consistent evidence that the CBAM is associated with a higher probability and conditional rate of emissions disclosure initiation among previously non-disclosing foreign suppliers, particularly when CBAM-related pressure is more likely to be transmitted through EU customer relationships.

5.2 Disclosure Initiation and Default-Value Incentives

We next examine whether disclosure initiation is concentrated among firms whose newly disclosed emissions fall below the proxy default-value benchmark defined in Section 4.4. We estimate separate cause-specific hazards for disclosures below and at or above this benchmark. When estimating each cause-specific hazard, firms initiating the alternative disclosure type are treated as censored at the time of their first disclosure.

Columns 3 and 4 of Table 8 show that the increased disclosure hazard among CBAM Exporters is concentrated in disclosures reporting relatively lower emissions. In Columns 3 and 4 we find hazard ratios on CBAM Exporter and CBAM Exporter × EU significantly greater than 1.0, indicating a higher conditional rate of initiating disclosure relative to control firms. In contrast, Columns 5 and 6 provide no evidence that CBAM Exporters are more likely to initiate disclosures reporting emissions at or above the proxy benchmark. The hazard ratios on CBAM Exporter and CBAM Exporter × EU are close to one and statistically insignificant. These findings are consistent with relatively cleaner CBAM Exporters having stronger incentives to disclose actual emissions because such information may be more valuable in comparison to prescribed default values.

6. Robustness and Additional Analyses

6.1 Alternative Emissions Measures

We re-estimate our main decarbonization analyses in Table 9, replacing emissions intensity with a variety of alternative emissions measures. In Panel A we examine the volume of firms' emissions. Because the intensity measures used in our primary analyses are emissions divided by revenue, it is unclear whether CBAM Exporters are reducing emissions volumes as well as emission intensity. We find results consistent with CBAM Exporters decreasing the overall volume of their emissions compared to control firms following the passage of the CBAM across all three measures of emissions volume.

Next, in Panel B we recalculate *GHGIntensity1&2* and *GHGIntensity2* using only location-based measures of Scope 2 emissions instead of using market-based measures when available. The CBAM allows firms to use a market-based approach for estimating Scope 2 emissions but requires strict conditions to be met. Because we are not able to independently verify whether firms' Trucost market-based Scope 2 emissions meet these criteria or not, this analysis helps address concerns that results could relate to the inclusion of market-based emissions reductions that would not qualify for the CBAM. As reported in Panel B, inferences are unchanged.

Finally, in Panel C we examine CBAM Exporters' upstream Scope 3 emissions. For certain "complex goods" the embedded emissions calculation for CBAM Products also includes emissions from the production of raw materials used that are CBAM goods themselves. In other words, CBAM Exporters may be incentivized to reduce some upstream Scope 3 emissions by the CBAM. As shown in Panel C, we find mixed evidence of decreases in upstream Scope 3 emissions for CBAM Exporters relative to control firms. We caveat this analysis by noting we cannot isolate the precise source of these reductions and highlight two non-mutually exclusive possible explanations: (1) the results are consistent with the CBAM creating incentives that extend upstream in the supply chain past the CBAM Exporter; and/or (2) the results could reflect shifts toward cleaner energy sources to reduce Scope 2 emissions that may mechanically lower lifecycle emissions associated with purchased electricity captured in Scope 3 emissions.

6.2 Emissions Measurement Precision

An alternative explanation for the observed differences in decarbonization for firms with vs. without pre-CBAM emissions disclosure could be that Trucost measures changes in emissions more precisely for firms that disclose emissions than for firms whose emissions are primarily modeled. To assess this possibility, we compare our primary Scope 1 emissions measure with independent emissions estimates from Climate TRACE for the subset of firms for which both measures are available. Climate TRACE uses satellite and sensor data to estimate emissions.

As shown in Table 10, the Trucost and Climate TRACE measures capture related variation in emissions levels and changes for firms both with and without pre-CBAM emissions disclosure. This finding indicates that the Trucost measures contain a common underlying emissions signal across both disclosure groups and partially alleviates concerns that the results are driven solely by measurement differences. However, the co-movement between the two measures is stronger when the Trucost estimates are based on firm-disclosed information, suggesting that measurement quality may differ across the disclosure partitions. Accordingly, this analysis does not fully eliminate the possibility that systematic differences in the precision of modeled vs. disclosed emissions contribute to the observed heterogeneity in estimated emissions reductions between firms with and without pre-CBAM disclosure.

6.3 Alternative Research Designs and Other Analyses

We also conduct a battery of additional robustness tests to assess the sensitivity of our findings to research design choices, including (a) adding control variables to decarbonization analyses, (b) alternative fixed-effects structures, (c) alternative clustering methods, (d) excluding years heavily affected by COVID-19, (e) excluding Chinese firms, (f) excluding countries with relatively fewer observations. Our inferences remain unchanged across these tests. All results are reported in the online appendix.

7. Conclusion

This paper examines how the CBAM affects foreign suppliers' decarbonization and emissions-disclosure decisions. Unlike traditional carbon pricing, under the CBAM, importers typically bear the formal reporting and payment obligations, while foreign suppliers generate the priced emissions and control the product-level information needed to accurately quantify them. Because suppliers can realize the economic benefits of lower emissions only when they can credibly measure and communicate them, this makes emissions abatement and information production potentially complementary responses.

We find that CBAM Exporters reduce emissions intensity following the regulation, with larger estimated responses among firms with greater observable exposure to EU Importers. The decarbonization response is also stronger among firms with pre-existing emissions disclosure and narrower portfolios of CBAM-covered products, consistent with emissions-information infrastructure and reporting complexity shaping firms' ability to respond. Reductions are concentrated among relatively lower emissions suppliers, for which reporting actual emissions may be more advantageous than relying on prescribed default values. We further find that previously non-disclosing CBAM Exporters are more likely to initiate emissions disclosure, particularly when exposure to EU Importers is greater and actual emissions information appears relatively advantageous.

Our findings contribute to research on carbon pricing, sustainability disclosure, and supply-chain environmental regulation by showing that a border carbon adjustment can induce both decarbonization and information production responses beyond the regulator's jurisdiction. The evidence also highlights that the effectiveness of cross-border carbon pricing depends not only on the strength of the carbon-price signal, but also on foreign suppliers' reporting environments including emissions information infrastructure, reporting complexity and relative emissions performance.

These insights have important implications. Border carbon adjustments may generate uneven responses when firms differ in their emissions information infrastructure or face substantially different product-level reporting burdens. Accordingly, efforts to expand carbon pricing across borders may be more effective when accompanied by investments in measurement standards, interoperable reporting systems, technical assistance, and credible verification capacity. Such investments may reduce the cost of demonstrating lower emissions, highlighting the importance of international coordination on monitoring, reporting, and verification standards for the effectiveness and fairness of emerging BCAs.

References

Alonso, M., Jacob, M., Ormazabal, G. and Raney, R.A., 2026. Cross-border carbon taxes and shareholder wealth. Forthcoming *Management Science.* https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4832122

Andersson, J. J. (2019). Carbon taxes and CO2 emissions: Sweden as a case study. *American Economic Journal: Economic Policy*, *11*(4), 1-30.

Aswani, J., Raghunandan, A. and Rajgopal, S., 2024. Are carbon emissions associated with stock returns?. *Review of Finance*, 28(1), pp.75-106.

Bellora, C., & Fontagné, L. (2023). EU in search of a Carbon Border Adjustment Mechanism. *Energy Economics*, *123*, 106673.

Bolton, P., & Kacperczyk, M. (2021). Do investors care about carbon risk?. *Journal of financial economics*, *142*(2), 517-549.

Bolton, P., Lam, A., & Muûls, M. (2023). Do carbon prices affect stock prices?. *Journal of Financial Research*.

Borghesi, S., Borghesi, Franco, C., and Marin, G., 2020. Outward Foreign Direct Investment Patterns of Italian Firms in the European Union's Emission Trading Scheme, *Scandinavian Journal of Economic*s, 122 (1), 219-256.

Bonetti, P., En, Y. E., Kadach, I., & Ormazabal, G. (2024). Climate Disclosures and Decarbonization along the Supply Chain. SSRN https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4850301.

Brink, C., Vollebergh, H.R. and van der Werf, E., 2016. Carbon pricing in the EU: Evaluation of different EU ETS reform options. *Energy Policy*, *97*, pp.603-617.

Chen, Y. C., Hung, M., & Wang, Y. 2018. The effect of mandatory CSR disclosure on firm profitability and social externalities: Evidence from China. *Journal of Accounting and Economics*, 65(1), 169-190.

Cho, B. K., Jung, H., Chung, J. B., & Song, C. K. (2024). Implications of the Carbon Border Adjustment Mechanism on South Korean industries: challenges and policy recommendations. *Journal of Cleaner Production*, *444*, 141278.

Christensen, H. B., Floyd, E., Liu, L. Y., and Maffett, M. 2017. The real effects of mandated information on social responsibility in financial reports: Evidence from mine-safety records. *Journal of Accounting and Economics*, 64 (2-3), 284-304.

Clora, F., Yu, W., & Corong, E. (2023). Alternative carbon border adjustment mechanisms in the European Union and international responses: aggregate and within-coalition results. *Energy Policy*, *174*, 113454.

Colmer, J., Martin, R., Muûls, M. and Wagner, U.J., 2025. Does pricing carbon mitigate climate change? firm-level evidence from the european union emissions trading system. *Review of Economic Studies*, *92*(3), pp.1625-1660.

Condon, M., 2023. What's Scope 3 Good For? *UC Davis Law Review*, 56 (5), 1921-1961.

Dai, J., Ormazabal, G., Penalva, F. and Raney, R., 2025. Mandatory investor disclosure, sustainability commitments, and portfolio decarbonization. *Journal of Accounting and Economics*, p.101817.

Dai, R., Liang, H., and Ng, L. (2021). Socially responsible corporate customers. *Journal of Financial Economics*, 142(2), 598-626

Dang, V. A., Gao, N., & Yu, T. (2023). Climate policy risk and corporate financial decisions: Evidence from the NOx budget trading program. *Management Science*, *69*(12), 7517-7539.

Darendeli, A., Fiechter, P., Hitz, J. M., & Lehmann, N. (2022). The role of corporate social responsibility (CSR) information in supply-chain contracting: Evidence from the expansion of CSR rating coverage. *Journal of Accounting and Economics*, 74(2-3), 101525.

Dechezleprêtre, A., Gennaioli, C., Martin, R., Muûls, M., and Stoerk, T., 2022. Searching for carbon leaks in multinational companies. *Journal of Environmental Economics and Management*, 112, 102601.

Downar, B., Ernstberger, J., Reichelstein, S., Schwenen, S., & Zaklan, A., 2021. The impact of carbon disclosure mandates on emissions and financial operating performance. *Review of Accounting Studies*, 26, 1137-1175.

Ducoulombier, F., 2021. Understanding the Importance of Scope 3 Emissions and the Implications of Data Limitations. *The Journal of Impact and ESG Investing*, 1 (4), 63-71.

Duflo, E., Greenstone, M., Pande, R., & Ryan, N. (2013). Truth-telling by third-party auditors and the response of polluting firms: Experimental evidence from India. *The Quarterly Journal of Economics*, 128(4), 1499-1545.

Fiechter , P., Hitz, J.-M., and Lehmann, N. 2022. Real Effects of a Widespread CSR Reporting Mandate: Evidence from the European Union's CSR Directive. *Journal of Accounting Research*, 60 (4), 1499-1549.

Fontagné, L., & Schubert, K. (2023). The economics of border carbon adjustment: rationale and impacts of compensating for carbon at the border. *Annual Review of Economics*, *15*(1), 389-424.

Fowlie, M., Petersen, C., & Reguant, M. (2021, May). Border carbon adjustments when carbon intensity varies across producers: evidence from California. In *AEA Papers and Proceedings* (Vol. 111, pp. 401-405). 2014 Broadway, Suite 305, Nashville, TN 37203: American Economic Association.

Gipper, B., Sequeira, F., & Shi, S. X. (2025). Carbon accounting quality: Measurement and the role of assurance. *Journal of Accounting and Economics*, 101849.

Hancock, A. and Mundy, S, 2025. EU makes fresh push for global carbon pricing ahead of 2026 levy. *The Financial Times*, October 16, 2025.

He, G., Wang, S., & Zhang, B. (2020). Watering down environmental regulation in China. *The Quarterly Journal of Economics*, 135(4), 2135-2185.

Jacob, M., Michaely, R. and Müller, M.A., 2019. Consumption taxes and corporate investment. *The Review of Financial Studies*, *32*(8), pp.3144-3182.

Jacob, M. and Zerwer, K.L., 2024. Emission taxes and capital investments: The role of tax incidence. *The Accounting Review*, *99*(5), pp.247-278.

IETA 2024. International reaction to the EU Carbon Border Adjustment Mechanism. *International Emissions Trading Association* (IETA) 2024.

Ivanov, I. T., Kruttli, M. S., & Watugala, S. W. (2024). Banking on carbon: Corporate lending and cap-and-trade policy. *The Review of Financial Studies*, *37*(5), 1640-1684.

Krueger, P., Sautner, Z., Tang, D.Y. and Zhong, R., 2024. The effects of mandatory ESG disclosure around the world. *Journal of Accounting Research*, *62*(5), pp.1795-1847.

Känzig, D. R. (2023). The unequal economic consequences of carbon pricing. *National Bureau of Economic Research*. No. w31221.

Li P., Lin Z., Du H., Feng T., and Zuo J. 2021. Do environmental taxes reduce air pollution? Evidence from fossil-fuel power plants in China. *Journal of Environmental Management*, 295:113112.

Martinsson, G., Sajtos, L., Strömberg, P. and Thomann, C., 2024. The effect of carbon pricing on firm emissions: Evidence from the Swedish CO2 tax. *The Review of Financial Studies*, *37*(6), pp.1848-1886.

Metcalf, G.E. and Stock, J.H., 2023. The macroeconomic impact of Europe's carbon taxes. *American Economic Journal: Macroeconomics*, *15*(3), pp.265-286.

Naegele, H., and Zaklan, A., 2019. Does the EU ETS cause carbon leakage in European manufacturing? *Journal of Environmental Economics and Management*, 93 (C), 125-147.

Pretis F. 2022. Does a carbon tax reduce CO2 emissions? Evidence from British Columbia. *Environmental and Resource Economics*, 83:115–144.

Rambachan, A., Roth, J., 2023. A more credible approach to parallel trends. *Review of Economic Studies*, 90 (5), 2555–2591.

Schiller, C. (2018, April). Global supply-chain networks and corporate social responsibility. In *13th Annual Mid-Atlantic Research Conference in Finance Paper*.

She, G. (2022). The real effects of mandatory nonfinancial disclosure: Evidence from supply chain transparency. *The Accounting Review*, *97*(5), 399-425.

Tomar, S. 2023. Greenhouse Gas Disclosure and Emissions Benchmarking. *Journal of Accounting Research*, 61 (2), 451-492.

Wang, L.L., 2023. Transmission effects of ESG disclosure regulations through bank lending networks. *Journal of Accounting Research*, *61*(3), pp.935-978.

Appendix A. Variable Definitions

Variable	Description	Source
GHGIntensity1&2	The natural log of total Scope 1 and Scope 2 GHG emissions intensity. Scope 2 intensity is calculated using market-based emissions where available and location-based emissions otherwise.	Trucost
GHGIntensity1	The natural log of total Scope 1 GHG emissions intensity.	Trucost
GHGIntensity2	The natural log of total Scope 2 GHG emissions intensity. Scope 2 intensity is calculated using market-based emissions where available and location-based emissions otherwise.	Trucost
GHG1&2	The natural log of total Scope 1 and Scope 2 GHG emissions. Scope 2 is calculated using market-based emissions where available and location-based emissions otherwise.	Trucost
GHG1	The natural log of total Scope 1 GHG emissions.	Trucost
GHG2	The natural log of total Scope 2 GHG emissions. Scope 2 is calculated using market-based emissions where available and location-based emissions otherwise.	Trucost
GHG Disclosure	Trucost variable *Weighted Contribution: GHG Disclosure.*	Trucost
CBAM Exporter	Indicator variable equal to one for firms exporting products pre-CBAM with an HS code classified in a CBAM-covered sector (see Appendix B), and zero otherwise.	Panjiva
Post	Indicator variable equal to one for years after 2022, and zero otherwise.	
Disclosure_Pre	Indicator variable equal to one for firms that reported carbon emissions as of year 2022, and zero otherwise. Measured based on nonzero values of Trucost variable *Weighted Contribution: GHG Disclosure.*	Trucost
EUCBAM%	Dollar share of CBAM-covered exports shipped to the European Union relative to total CBAM-covered exports	Panjiva
#CBAMCodes	The number of distinct CBAM product codes exported by a CBAM Exporter in the pre-CBAM reference year	Panjiva
Disclosure Post	Indicator variable equal to one for firms with *Disclosure Pre* = 0 that subsequently reported a non-zero value of the Trucost variable *Weighted Contribution: GHG Disclosure*	Trucost
Revenue	The natural log of total sales	Trucost
Profitability	Net income scaled by total assets.	Compustat
OCF	Operating cash flow scaled by total assets	Compustat
Loss	Indicator variable equal to one if a firm reports negative net income, and zero otherwise.	Compustat
Leverage	Total debt scaled by total assets. Total debt is the sum of long-term debt and the debt in current liabilities	Compustat
SalesGrowth	The annual percentage change in a firm's sales	Compustat
CashRatio	Cash and short-term investments scaled by total assets.	Compustat

Appendix B. CBAM Products

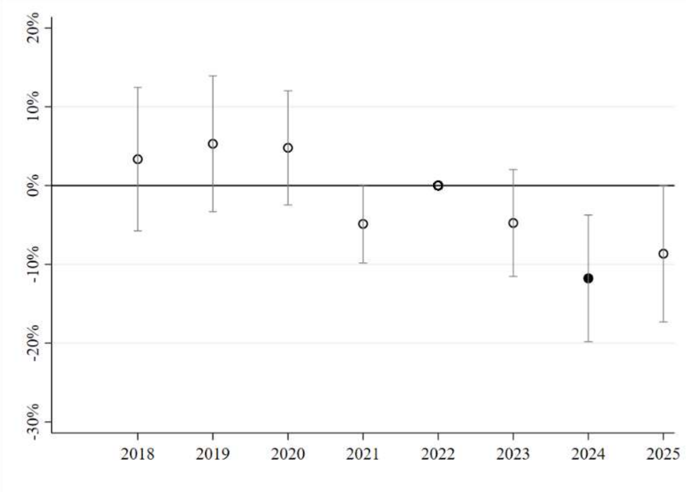
This appendix summarizes the list of products covered by the CBAM. The CBAM applies to products produced mostly in the following six sectors: iron and steel, cement, aluminum, fertilizers, hydrogen and electricity generation. To determine whether a product is covered by CBAM, an importer needs to check whether the imported product is listed on the Combined Nomenclature (CN) list specified in Annex II of the CBAM implementing regulation (Commission Implementing Regulation (EU) 2023/1773). Below we summarize the 4-digit and 6-digit HS_Codes that correspond to the full list of CBAM Products from the CBAM. We use these codes to identify CBAM Exporters.

CBAM Sectors	HS codes
Cement	250700, 252310, 252321, 252329, 252390, 252330
Electricity	271600
Fertilizer	280800, 310210, 281410, 281420, 283421, 310221, 310230, 310240, 310250, 310260, 310280, 310290, 310510, 310520, 310530, 310540, 310551, 310590
Steel	260112, 7201, 72021, 72024, 72026, 7206, 7207, 7218, 7224, 7205, 7208, 7209, 7210, 7211, 7212, 7213, 7214, 7215, 7216, 7217, 7219, 7220, 7221, 7222, 7223, 7225, 7226, 7227, 7228, 7229, 7301, 7302, 7303, 7304, 7305, 7306, 7307, 7308, 7309, 7310, 7311, 7318, 7326
Aluminum	7601, 7603, 7604, 7605, 7606, 7607, 7608, 760900, 7610, 761100, 7612, 761300, 7614, 7616
Hydrogen	280410

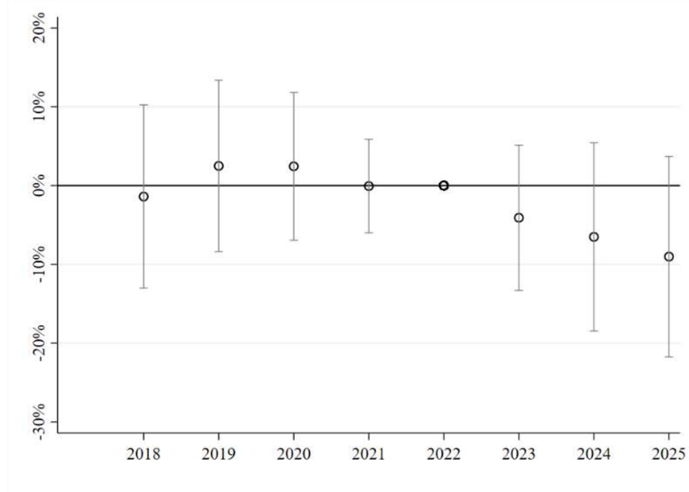
Figure 1: Full Sample CBAM Treatment Effects over Time

This figure plots yearly treatment point estimates together with the 95% confidence intervals for *Log(EmissionIntensity)* around the passage of the CBAM. Panel A examines *GHG Intensity 1&2*, Panel B *GHG Intensity 1* and Panel C *GHG Intensity 2*. We omit *2022 × CBAM Exporter*, which serves as the benchmark.

Panel A. *GHG Intensity 1&2*



Panel B. *GHG Intensity 1*



Panel C. *GHG Intensity 2*

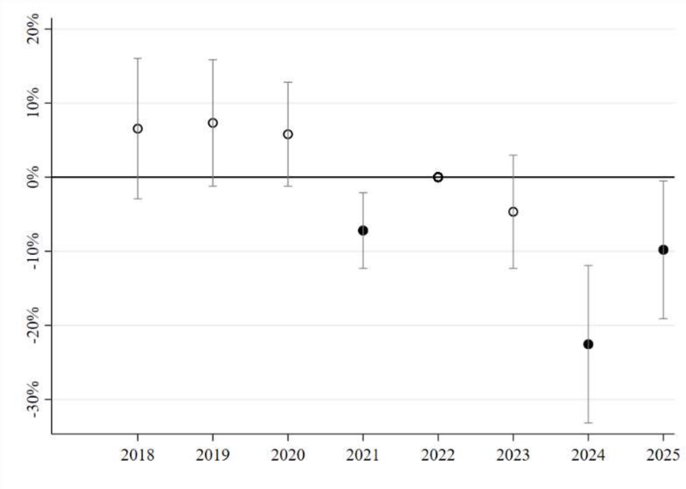
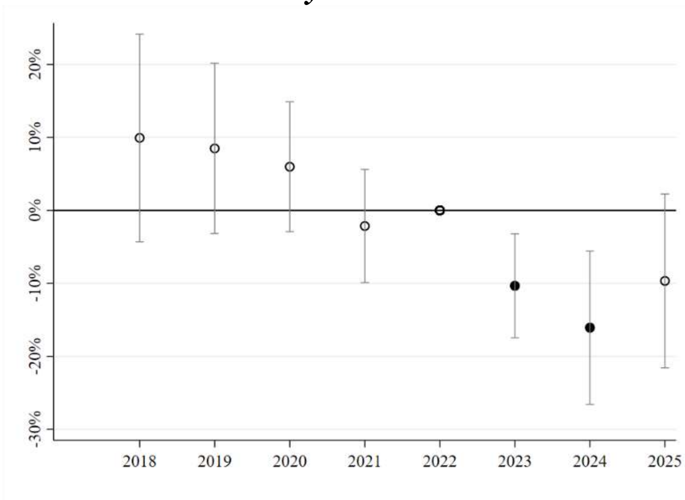


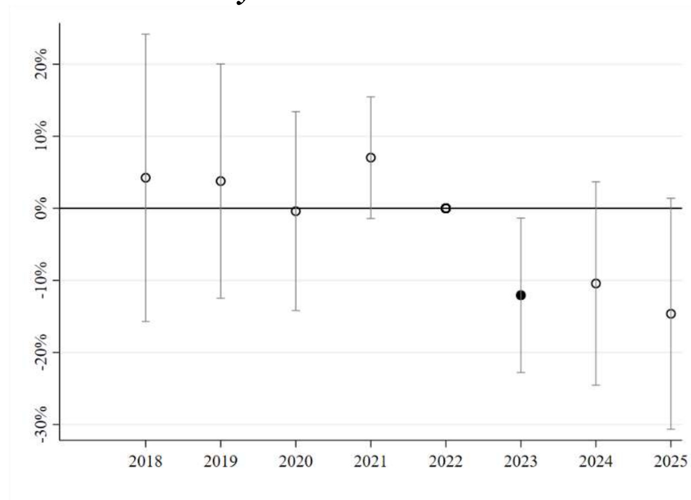
Figure 2: CBAM Treatment Effects over Time for Firms with Pre-CBAM Emissions Disclosure

This figure plots yearly treatment point estimates together with the 95% confidence intervals for *Log(EmissionIntensity)* around the passage of the CBAM for firms where *Disclosure_Pre*=1. Panel A examines *GHG Intensity 1&2*, Panel B *GHG Intensity 1* and Panel C *GHG Intensity 2*. We omit *2022 × CBAM Exporter*, which serves as the benchmark.

Panel A. *GHG Intensity 1&2*



Panel B. *GHG Intensity 1*



Panel C. *GHG Intensity 2*

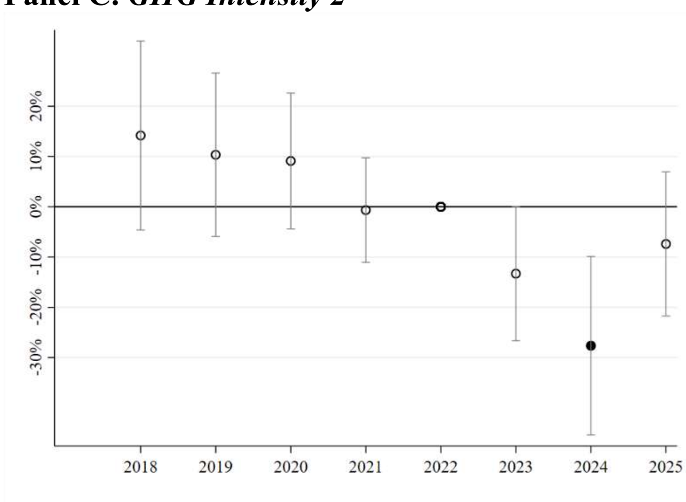
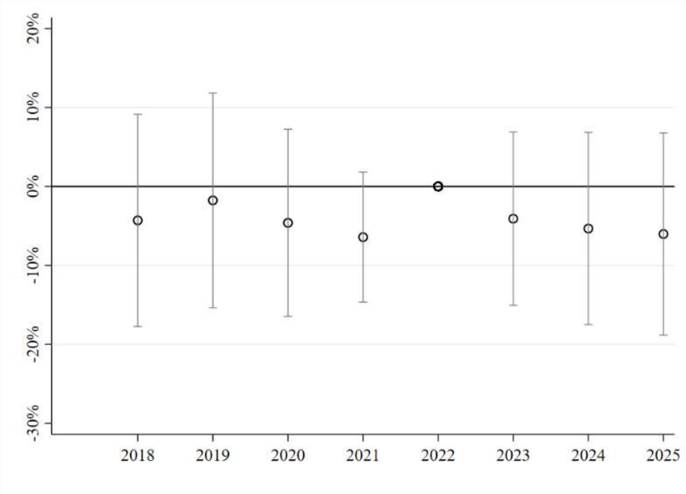


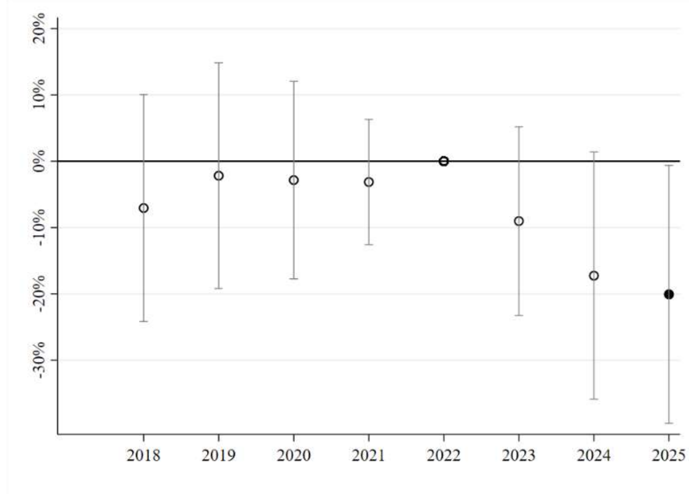
Figure 3: CBAM Treatment Effects over Time for Firms without Pre-CBAM Emissions Disclosure

This figure plots yearly treatment point estimates together with the 95% confidence intervals for *Log(EmissionIntensity)* around the passage of the CBAM for firms where *Disclosure_Pre*=0. Panel A examines *GHG Intensity 1&2*, Panel B *GHG Intensity 1* and Panel C *GHG Intensity 2*. We omit *2022 × CBAM Exporter*, which serves as the benchmark.

Panel A. *GHG Intensity 1&2*



Panel B. *GHG Intensity 1*



Panel C. *GHG Intensity 2*

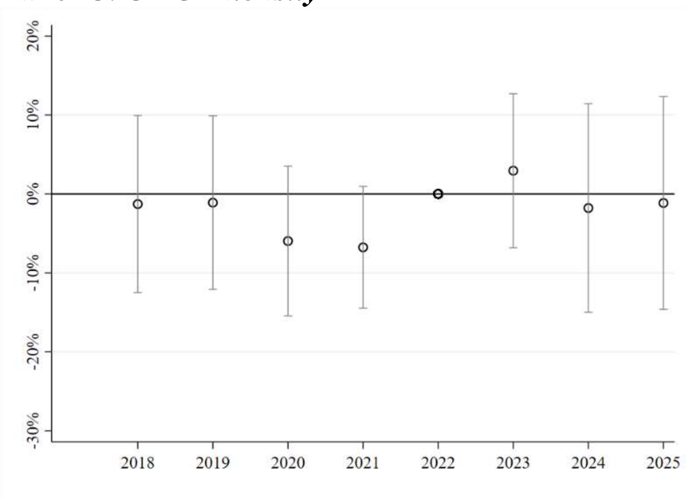


Table 1. Sample

Panel A presents the sample selection process. Panel B shows the distribution of firm-year observations across country of domicile partitioning by "Treatment" and "Control" firms. Panel C shows the distribution of firm-year observations across industry partitioning by "Treatment" and "Control" firms. All variables are defined in Appendix A.

Panel A. Sample Selection

Sample Firms	#Unique Firms
Firms with Trucost data (2018-2025)	44,064
Less: Non-publicly listed firms	(14,342)
Less: Firms classified as Transportation, Trading and Distributors	(1,182)
Less: Firms without observations as of year 2022	(10,940)
Less: Countries without corresponding Panjiva export data	(9,681)
Less: Firms with inconsistent disclosure status before 2022	(1,518)
Less: Industries with limited CBAM-exporter representation	(3,737)
Final sample	2,664

Panel B. Sample Breakdown by Country

Countries	*CBAM Exporter ("Treatment Group")*	*Other Non-EU Suppliers ("Control Group")*	Total
Brazil	32	224	256
China	823	8,694	9,517
India	411	1,518	1,929
Mexico	64	119	183
Pakistan	35	104	139
United States	914	2901	3,815
Other*	56	309	365
Total	2,335	13,869	16,204

* Other includes firms from Chile, Colombia, Indonesia, Peru, Sri Lanka, and Vietnam.

Panel C. Sample Breakdown by Industry

Industries	*CBAM Exporter ("Treatment Group")*	*Other Non-EU Suppliers ("Control Group")*	Total
Aerospace & Defense	83	419	502
Automobile Components	153	633	786
Beverages	40	299	339
Building Products	60	218	278
Chemicals	254	1,778	2,032
Communications Equipment	61	585	646
Construction Materials	68	299	367
Construction & Engineering	100	826	926
Containers & Packaging	96	218	314
Electrical Equipment	101	1,206	1,307
Electronic Instruments & Components	163	1,238	1,401
Energy Equipment & Services	47	267	314
Household Durables	104	568	672
Industrial Conglomerates	72	81	153
Machinery	428	1,429	1,857
Metals & Mining	278	1,176	1,454
Multi-Utilities	8	89	97
Pharmaceuticals	116	1,347	1,463
Semiconductors & Equipment	87	1,008	1,095
Water Utilities	16	185	201
	2,335	13,869	16,204

Table 2. Descriptive Statistics

This table provides descriptive statistics of the variables used in the analysis. Variables are defined in Appendix A.

Variables	N	Mean	SD	p25	p50	p75
Emissions Measures						
GHGIntensity1&2	16,204	4.431	1.425	3.434	4.008	5.182
GHGIntensity1	16,204	3.602	1.750	2.564	3.210	4.386
GHGIntensity2	16,204	3.454	1.172	2.612	3.249	4.145
GHG1&2	16,204	10.706	2.560	9.118	10.529	12.326
GHG1	16,204	9.874	2.775	8.206	9.670	11.466
GHG2	16,204	9.717	2.381	8.284	9.668	11.278
GHGIntensity1&2_Location	16,204	4.437	1.420	3.436	4.011	5.187
GHGIntensity2_Location	16,204	3.475	1.151	2.631	3.255	4.158
GHGIntensity3	16,204	5.171	0.639	4.785	5.225	5.632
GHG3	16,204	11.455	2.140	10.276	11.517	12.806
CBAM Exposure & Disclosure						
CBAM Exporter	16,204	0.144	0.351	0.000	0.000	0.000
GHG Disclosure	16,204	26.849	43.711	0.000	0.000	94.663
Disclosure_Pre	16,204	0.206	0.405	0.000	0.000	0.000
EUCBAM%	2,335	0.095	0.233	0.000	0.000	0.025
#CBAMCodes	2,335	5.111	5.312	2.000	3.000	6.000
Disclosure Post	2,141	0.209	0.407	0.000	0.000	0.000
Firm-Level Control Variables						
Revenue	16,204	6.298	1.892	5.257	6.288	7.436
Profitability	15,555	0.014	0.241	0.007	0.037	0.075
OCF	15,650	0.045	0.146	0.014	0.057	0.102
Loss	15,778	0.196	0.397	0.000	0.000	0.000
Leverage	15,563	0.207	0.198	0.056	0.178	0.311
SalesGrowth	15,558	0.378	15.728	-0.045	0.075	0.218
CashRatio	15,696	0.197	0.166	0.079	0.156	0.265

Table 3. CBAM Exposure and Foreign Supplier Decarbonization

This table presents results from examining *EmissionsIntensity* around the passage of the CBAM. The analysis is conducted at the firm-year level. We present three different measures of *EmissionsIntensity* in each panel; *GHGIntensity1&2* in Column 1, *GHGIntensity1* in Column 2, and *GHGIntensity2* in Column 3. *CBAM Exporter* is an indicator variable that equals one if the firm exported CBAM Products prior to the passage of the CBAM, and zero otherwise. *Post* is an indicator variable that equals one for observations after 2022, and zero otherwise. Panel A includes all *CBAM Exporter* firms in a single treatment group. Panel B splits *CBAM Exporter* firms into lower (*L*) middle (*M*) and higher (*H*) partitions based on pre-CBAM observable supply chain relationships with EU Importers (*EUCBAM%)*. Standard errors are clustered by firm. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

Panel A. Changes around the Passage of the CBAM

Dependent Var:	*GHGIntensity1&2*	*GHGIntensity1*	*GHGIntensity2*
	(1)	(2)	(3)
CBAM Exporter×Post	-0.098**	-0.071	-0.226***
	(0.041)	*(0.058)*	*(0.056)*
Firm FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	16,204	16,204	16,204
R-squared	0.921	0.906	0.924

Panel B. Variation with Exposure to EU CBAM Customers

Dependent Var:	*GHGIntensity1&2*	*GHGIntensity1*	*GHGIntensity2*
	(1)	(2)	(3)
CBAM Exporter L_EU×Post	-0.077	-0.020	-0.098*
	(0.055)	*(0.077)*	*(0.054)*
CBAM Exporter M_EU×Post	-0.121	-0.136	-0.150*
	(0.086)	*(0.128)*	*(0.077)*
CBAM Exporter H_EU×Post	-0.142**	-0.167*	-0.284***
	(0.064)	*(0.093)*	*(0.097)*
Firm FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	16,204	16,204	16,204
R-squared	0.921	0.906	0.855

Table 4. Pre-CBAM Emissions Disclosure and Decarbonization

This table presents cross-sectional variation in *EmissionsIntensity* around the passage of the CBAM based on firms' pre-CBAM disclosure of firm emissions. Odd columns include firms with pre-CBAM emissions disclosure (*Disclosure_Pre* = 1) and even columns include firms without pre-CBAM emissions disclosure (*Disclosure_Pre* = 0). We present three different measures of *EmissionsIntensity*; *GHGIntensity1&2* in Column 1, *GHGIntensity1* in Column 2, and *GHGIntensity2* in Column 3. *CBAM Exporter* is an indicator variable that equals one if the firm exported CBAM Products prior to the passage of the CBAM, and zero otherwise. *Post* is an indicator variable that equals one for observations after 2022, and zero otherwise. We also report tests of the difference in the estimated *CBAM Exporter* × *Post* coefficient between the *Disclosure_Pre* = 1 and *Disclosure_Pre* = 0 samples. Standard errors are clustered by firm. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

Dependent Var:		GHGIntensity1&2		GHGIntensity1		GHGIntensity2	
Pre-CBAM Disclosure?		Yes	No	Yes	No	Yes	No
		(1)	(2)	(3)	(4)	(5)	(6)
CBAM Exporter×Post	β	-0.161***	-0.019	-0.152**	-0.125	-0.222***	0.030
		(0.046)	*(0.066)*	*(0.068)*	*(0.093)*	*(0.060)*	*(0.062)*
β (i) – **β (i+1)** where i = 1,3,5		-0.142*		-0.027		-0.252***	
		(1.75)		*(0.23)*		*(2.92)*	
Firm FE		YES	YES	YES	YES	YES	YES
Year FE		YES	YES	YES	YES	YES	YES
Observations		3,343	12,861	3,343	12,861	3,343	12,861
R-squared		0.956	0.899	0.954	0.873	0.865	0.849

Table 5. Breadth of CBAM Product Coverage and Decarbonization

This table presents cross-sectional variation in *EmissionsIntensity* around the passage of the CBAM based on the breadth of CBAM products exported by *CBAM Exporter* firms. *Narrower CBAM Exporter* (*Broader CBAM Exporter)* is an indicator variable that equals one if the number of distinct CBAM codes exported by a firm is below (above) the median for *CBAM Exporter* firms. We present three different measures of *EmissionsIntensity* in each panel; *GHGIntensity1&2* in Column 1, *GHGIntensity1* in Column 2, and *GHGIntensity2* in Column 3. *Post* is an indicator variable that equals one for observations after 2022, and zero otherwise. *Disclosure_Pre* is an indicator variable that equals one for firms with pre-CBAM emissions disclosure and zero otherwise. Standard errors are clustered by firm. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

Dependent Var:		GHGIntensity1&2	GHGIntensity1	GHGIntensity2	GHGIntensity1&2	GHGIntensity1	GHGIntensity2
Narrower CBAM Exporter×Post	β_1	-0.160***	-0.174**	-0.180***	-0.147*	-0.306***	-0.041
		(0.050)	*(0.077)*	*(0.056)*	*(0.078)*	*(0.118)*	*(0.083)*
Broader CBAM Exporter ×Post	β_2	-0.026	0.048	-0.103*	0.137	0.092	0.120
		(0.063)	*(0.082)*	*(0.060)*	*(0.106)*	*(0.140)*	*(0.087)*
Narrower CBAM Exporter ×Post×Disclosure_Pre	β_3				-0.007	0.138	-0.185*
					(0.099)	*(0.150)*	*(0.111)*
Broader CBAM Exporter ×Post×Disclosure_Pre	β_4				-0.320***	-0.237	-0.353***
					(0.119)	*(0.162)*	*(0.114)*
Post×Disclosure_Pre					-0.032	0.224***	-0.175***
					(0.032)	*(0.044)*	*(0.043)*
Narrow vs Broad: ($\beta_1 - \beta_2$)		-0.134*	-0.222**	-0.077			
		(1.723)	*(2.035)*	*(0.970)*			
Narrow vs Broad | *Disclosure_Pre=0:* ($\beta_1 - \beta_2$)					-0.284**	-0.398**	-0.160
					(2.196)	*(2.205)*	*(1.358)*
Narrow vs Broad | *Disclosure_Pre=1:* ($\beta_1+\beta_3$) – ($\beta_2+\beta_4$)					0.030	-0.028	0.008
					(0.407)	*(0.215)*	*(0.089)*
Firm FE		YES	YES	YES	YES	YES	YES
Year FE		YES	YES	YES	YES	YES	YES
Observations		16,204	16,204	16,204	16,204	16,204	16,204
R-squared		0.921	0.906	0.855	0.922	0.906	0.857

Table 6. Relative Pre-CBAM Emissions Intensity and Decarbonization

This table presents cross-sectional variation in *EmissionsIntensity* around the passage of the CBAM based on how CBAM Exporter's emission intensity pre-CBAM compares to its country average. *LEmissions CBAM Exporter* (*HEmissions CBAM Exporter)* is an indicator variable that equals one if the firm's pre-CBAM *GHGIntensity1&2* is below (above) 1.1x the average *GHGIntensity1&2* for *CBAM Exporters* from the same country. Column 1 includes all firms. Column 2 excludes broader-scope CBAM Exporters, Column 3 retains firms with pre-CBAM disclosure, and Column 4 applies both restrictions. We present *GHGIntensity1&2* in Panel A, *GHGIntensity1* in Panel B, and *GHGIntensity2* in Panel C. Standard errors are clustered by firm. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

Panel A. Dependent Variable GHGIntensity1&2

Sample Exclusions:		None	*Broad CBAM=1*	*Disclosure_pre=0*	*Broad CBAM=1 Disclosure_pre=0*
		(1)	(2)	(3)	(4)
LEmissions CBAM Exporter×Post	β_1	-0.127***	-0.194***	-0.230***	-0.234***
		(0.043)	*(0.057)*	*(0.049)*	*(0.074)*
HEmissions CBAM Exporter×Post	β_2	-0.024	-0.083	-0.027	-0.024
		(0.092)	*(0.095)*	*(0.076)*	*(0.091)*
Low vs High: (β_1 – β_2)		-0.103	-0.111	-0.203**	-0.211*
		(1.038)	*(1.021)*	*(2.503)*	*(1.910)*
Firm & Year FE		YES	YES	YES	YES
Observations		16,204	15,130	3,343	2,835
R-squared		0.921	0.922	0.956	0.955

Panel B. Dependent Variable GHGIntensity1

Sample Exclusions		None	*Broad CBAM=1*	*Disclosure_pre=0*	*Broad CBAM=1 Disclosure_pre=0*
		(1)	(2)	(3)	(4)
LEmissions CBAM ×Post	β_1	-0.136**	-0.262***	-0.233***	-0.293**
		(0.066)	*(0.096)*	*(0.083)*	*(0.127)*
HEmissions CBAM×Post	β_2	0.096	0.027	0.006	0.028
		(0.109)	*(0.111)*	*(0.089)*	*(0.103)*
Low vs High: (β_1 – β_2)		-0.231*	-0.288**	-0.240**	-0.321**
		(1.862)	*(2.005)*	*(2.223)*	*(2.087)*
Firm & Year FE		YES	YES	YES	YES
Observations		16,204	15,130	3,343	2,835
R-squared		0.906	0.906	0.954	0.955

Panel C. Dependent Variable GHGIntensity2

Sample Exclusions		None	*Broad CBAM=1*	*Disclosure_pre=0*	*Broad CBAM=1 Disclosure_pre=0*
		(1)	(2)	(3)	(4)
LEmissions CBAM ×Post	β_1	-0.137***	-0.171***	-0.253***	-0.251***
		(0.041)	*(0.052)*	*(0.059)*	*(0.079)*
HEmissions CBAM×Post	β_2	-0.163	-0.202	-0.163	-0.177
		(0.104)	*(0.137)*	*(0.107)*	*(0.125)*
Low vs High: (β_1 – β_2)		0.026	0.031	-0.090	-0.074
		(0.233)	*(0.215)*	*(0.839)*	*(0.551)*
Firm & Year FE		YES	YES	YES	YES
Observations		16,204	15,130	3,343	2,835
R-squared		0.855	0.857	0.865	0.863

Table 7. Probability of Emissions Disclosure Initiation Following the CBAM

This table examines whether firms initiate emissions disclosure following the passage of the CBAM. The sample is limited to firms where *Disclosure_Pre* = 0 and is collapsed to one observation per firm. The dependent variable, *Disclosure Post* is an indicator variable that equals one if the firm initiated emissions disclosure in any year after 2022. *EU* is an indicator variable that equals one if a CBAM Exporter has observable pre-CBAM supply-chain relationships with EU Importers (*EUCBAM% > 0)*. Control variables are based on 2022 data and defined in Appendix A. Standard errors are robust. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

Dependent Var:	*Disclosure Post*	*Disclosure Post*	*Disclosure Post*	*Disclosure Post*
	(1)	(2)	(3)	(4)
CBAM Exporter	0.247***	0.184***	0.132***	0.074*
	(0.037)	*(0.042)*	*(0.037)*	*(0.042)*
CBAM Exporter×EU		0.204***		0.188***
		(0.077)		*(0.073)*
Revenue			0.085***	0.084***
			(0.006)	*(0.006)*
Profitability			-0.180**	-0.174**
			(0.074)	*(0.074)*
OCF			-0.038	-0.036
			(0.087)	*(0.087)*
Loss			-0.063**	-0.061**
			(0.025)	*(0.025)*
Leverage			-0.162***	-0.160***
			(0.054)	*(0.054)*
SalesGrowth			0.031*	0.032*
			(0.017)	*(0.017)*
CashRatio			0.198***	0.194***
			(0.056)	*(0.056)*
Industry Strata	YES	YES	YES	YES
Country Strata	YES	YES	YES	YES
Observations	2,187	2,187	1,977	1,977
R-squared	0.066	0.070	0.156	0.160

Table 8. Emissions Disclosure Initiation and Default-Value Incentives

This table examines the timing of emissions disclosure initiation following the passage of the CBAM. The sample is limited to firms where *Disclosure_Pre* = 0 and includes firm-year observations from 2022 through 2025. We estimate Cox proportional hazards regressions in which the event time is the number of years until a firm first initiates emissions disclosure. Firms that do not initiate disclosure by the end of the sample period are treated as right censored. In Columns 1 and 2, any disclosure initiation is classified as an event. In Columns 3 and 4, we classify as an event disclosure initiation for which the newly disclosed *GHGIntensity1&2* is below 1.1 times the average *GHGIntensity1&2* of CBAM Exporters from the same country-year. In Columns 5 and 6, we classify as an event a disclosure initiation for which the newly disclosed *GHGIntensity1&2* is at or above that benchmark. Reported coefficients are hazard ratios and are interpreted relative to a value of one; hazard ratios greater than one indicate a higher conditional rate of disclosure initiation. Disclosure initiations that do not meet the relevant event definition in Columns 3 to 6 are treated as censored at the time of initiation. *EU* is an indicator variable that equals one if a CBAM Exporter has observable pre-CBAM supply-chain relationships with EU Importers (*EUCBAM% > 0)*. Control variables are based on 2022 data and defined in Appendix A. *z-statistics* in parentheses are based on robust standard errors by firm. *** p<0.01, ** p<0.05, * p<0.1 (two-tailed).

Dependent Var:	Periods until Initial Emissions Disclosure					
Event:	Disclosure		Lower Disclosure		Higher Disclosure	
	(1)	(2)	(3)	(4)	(5)	(6)
CBAM Exporter	1.502***	1.274	1.801***	1.442*	1.017	0.979
	(0.170)	*(0.188)*	*(0.267)*	*(0.280)*	*(0.228)*	*(0.283)*
CBAM Exporter×EU		1.526**		1.754**		1.106
		(0.289)		*(0.417)*		*(0.474)*
Revenue	1.481***	1.477***	1.467***	1.463***	1.487***	1.486***
	(0.048)	*(0.048)*	*(0.061)*	*(0.061)*	*(0.082)*	*(0.082)*
Profitability	4.996*	5.495*	4.963	5.307	3.357	3.473
	(4.353)	*(4.835)*	*(5.603)*	*(5.998)*	*(5.471)*	*(5.711)*
OCF	0.802	0.774	0.499	0.466	2.277	2.268
	(0.507)	*(0.493)*	*(0.447)*	*(0.419)*	*(2.153)*	*(2.146)*
Loss	0.678*	0.687*	0.695	0.699	0.591	0.594
	(0.143)	*(0.145)*	*(0.179)*	*(0.180)*	*(0.223)*	*(0.225)*
Leverage	0.585	0.590	0.349**	0.347**	1.228	1.235
	(0.199)	*(0.200)*	*(0.166)*	*(0.165)*	*(0.689)*	*(0.695)*
SalesGrowth	1.123	1.124	0.926	0.930	1.386**	1.384**
	(0.110)	*(0.111)*	*(0.140)*	*(0.141)*	*(0.220)*	*(0.221)*
CashRatio	1.487	1.463	2.068	2.026	0.710	0.707
	(0.597)	*(0.585)*	*(1.078)*	*(1.049)*	*(0.483)*	*(0.482)*
Country FE	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
Observations	6,681	6,681	6,681	6,681	6,681	6,681

Table 9. Alternative Emissions Measures

This table repeats the analysis in Table 3 replacing emission intensity measures with alternative measures of emissions. The analysis is conducted at the firm-year level. In Panel A we examine emissions volume. In Panel B we use location-based information for Scope 2 emissions in the calculation of emission intensity. In Panel C we examine measures of non-EU suppliers' upstream Scope 3 emissions. *CBAM Exporter* is an indicator variable that equals one if the firm exported CBAM Products prior to the passage of the CBAM, and zero otherwise. *Post* is an indicator variable that equals one for observations after 2022, and zero otherwise. Standard errors are clustered by firm. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

Panel A. Emissions Volume

Dependent Var:	*GHG1&2*	*GHG1*	*GHG2*
	(1)	(2)	(3)
CBAM Exporter×Post	-0.151***	-0.129**	-0.226***
	(0.047)	*(0.064)*	*(0.056)*
Firm FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	16,204	16,204	16,204
R-squared	0.921	0.906	0.924

Panel B. Using Location Based Emissions for Scope2

Dependent Var:	*GHG1&2*	*GHG1*	*GHG2*
	(1)	(2)	(3)
CBAM Exporter×Post	-0.077*	-0.071	-0.083**
	(0.040)	*(0.058)*	*(0.039)*
Firm FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	16,204	16,204	16,204
R-squared	0.923	0.906	0.873

Panel C. Upstream Scope 3 Emissions

Dependent Var:	*GHGIntensity3*	*GHG3*
	(1)	(2)
CBAM Exporter×Post	0.003	-0.045*
	(0.013)	*(0.026)*
Firm FE	YES	YES
Year FE	YES	YES
Observations	16,204	16,204
R-squared	0.930	0.967

Table 10. Emissions Measurement Precision

This table compares Trucost Scope 1 emissions with Climate Trace satellite-based emissions and re-examines changes in emission intensity around the passage of the CBAM using Climate Trace emissions. Panel A reports Pearson correlations in levels and first differences and Cohen's κ examining consistency in the direction of annual emissions changes. Results for the full sample are shown in Column (1) and separately for observations with and without ex ante disclosure of firm emissions (Disclosure_Pre = 1 and Disclosure_Pre = 0) in columns (2) and (3) respectively. Panel B reports regressions of Climate Trace emissions (*GHGIntensity1_CT*) on Trucost emissions (*GHGIntensity1)*, *Disclosure_Pre*, and the interaction between *GHGIntensity1* and *Disclosure_Pre*. Columns 1 and 2 use emissions levels, while Columns 3 and 4 use first differences of emissions. Panel C re-estimates the main analyses presented in Tables 3 and 4 using Climate Trace emissions intensity in place of Trucost emissions intensity. In addition, Panel C reports tests of the difference in the estimated *CBAM Exporter* × *Post* coefficient between the *Disclosure_Pre* = 1 and *Disclosure_Pre* = 0 samples. Climate Trace emissions are estimated using satellite observations and related remote sensing technologies. Standard errors are clustered by firm. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

Panel A. Univariate- Scope1

	Full Sample	Disclosure_Pre=1	Disclosure_Pre=0
	(1)	(2)	(3)
Correlation in Levels	0.457***	0.600***	0.333***
Correlation in Changes	0.187***	0.310***	0.138***
Cohen's κ	0.177***	0.190***	0.181***
Observations	939	450	489

Panel B. Multivariate in Level

Dependent Variable:	*GHGIntensity1_CT*			
	Emissions in Levels		Emissions in Changes	
	(1)	(2)	(3)	
GHGIntensity1	0.673***	0.544***	0.094***	0.052*
	(0.096)	*(0.101)*	*(0.028)*	*(0.027)*
GHGIntensity1×Disclosure_Pre		0.330***		0.190**
		(0.123)		*(0.075)*
Disclosure_Pre		-2.582***		-0.027
		(0.838)		*(0.019)*
Industry FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	939	939	939	939
R-squared	0.379	0.421	0.085	0.106

Panel C. Emission Intensity Changes Around the Passage of the CBAM

Dependent Variable:		*GHGIntensity1_CT*		
		Full Sample	Disclosure_Pre=1	Disclosure_Pre=0
		(1)	(2)	(3)
CBAM Exporter×Post	β	0.012	-0.007	0.096
		(0.039)	*(0.052)*	*(0.078)*
β (2) – β (3)			-0.103	
			(1.10)	
Firm FE		YES	YES	YES
Year FE		YES	YES	YES
Observations		935	450	485
R-squared		0.993	0.994	0.991

Online Appendix

Table OA1. Additional Robustness Tests

This table repeats the analysis in Table 3 across a series of alternative research designs. Panel A includes firm-level control variables. Panel B replaces year fixed effects with country-year fixed effects. Panel C replaces firm fixed effects with country and industry fixed effects. Panel D uses country-industry clustering of standard errors. Panel E excludes all sample observations from 2020, the year most heavily impacted by the COVID Pandemic. Panel F excludes Chinese firms. Panel G excludes observations from the "Other" countries with relatively small numbers of firm-year observations. We present three different measures of *EmissionsIntensity* in each panel; *GHGIntensity1&2* in Column 1, *GHGIntensity1* in Column 2, and *GHGIntensity2* in Column 3. *CBAM Exporter* is an indicator variable that equals one if the firm exported CBAM Products prior to the passage of the CBAM, and zero otherwise. *Post* is an indicator variable that equals one for observations after 2022, and zero otherwise. Standard errors are clustered by firm. *t-statistics* are in parentheses. *, ** and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

Panel A. Adding Control Variables

Dependent Var:	GHGIntensity1&2	GHGIntensity1	GHGIntensity2
	(1)	(2)	(3)
*CBAM Exporter*Post*	-0.107***	-0.074	-0.217***
	(0.041)	*(0.058)*	*(0.056)*
$Profitability_{t-1}$	0.069	0.055	0.506***
	(0.060)	*(0.082)*	*(0.149)*
OCF_{t-1}	-0.136	-0.194*	0.240
	(0.088)	*(0.116)*	*(0.152)*
$Loss_{t-1}$	-0.002	0.001	-0.084***
	(0.020)	*(0.025)*	*(0.030)*
$Leverage_{t-1}$	-0.052	-0.178*	0.562***
	(0.084)	*(0.107)*	*(0.146)*
$SalesGrowth_{t-1}$	-0.027**	-0.029	0.241***
	(0.012)	*(0.018)*	*(0.024)*
$CashRatio_{t-1}$	0.110	0.148	-0.467***
	(0.083)	*(0.106)*	*(0.152)*
Firm FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	13,709	13,709	13,709
R-squared	0.922	0.907	0.919

Panel B. Country-Year and Firm FEs

Dependent Var:	GHGIntensity1&2	GHGIntensity1	GHGIntensity2
	(1)	(2)	(3)
*CBAM Exporter*Post*	-0.067	-0.110*	-0.179***
	(0.041)	*(0.059)*	*(0.059)*
Firm FE	YES	YES	YES
Country-Year FE	YES	YES	YES
Observations	16,203	16,203	16,203
R-squared	0.922	0.906	0.925

Panel C. Country, Industry, Year FEs

Dependent Var:	GHGIntensity1&2	GHGIntensity1	GHGIntensity2
	(1)	(2)	(3)
*CBAM Exporter*Post*	-0.083*	-0.051	-0.159**
	(0.044)	*(0.062)*	*(0.066)*
CBAM Exporter	0.140**	0.102	2.111***
	(0.058)	*(0.072)*	*(0.113)*
Country FE	YES	YES	YES
Industry FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	16,252	16,252	16,252
R-squared	0.498	0.459	0.312

Panel D. Country-Industry SE Clustering

Dependent Var:	GHGIntensity1&2	GHGIntensity1	GHGIntensity2
	(1)	(2)	(3)
*CBAM Exporter*Post*	-0.098*	-0.071	-0.226**
	(0.051)	*(0.059)*	*(0.092)*
Firm FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	16,204	16,204	16,204
R-squared	0.921	0.906	0.924

Panel E. Excluding Observations from 2020

Dependent Var:	GHGIntensity1&2	GHGIntensity1	GHGIntensity2
	(1)	(2)	(3)
*CBAM Exporter*Post*	-0.091**	-0.068	-0.214***
	(0.040)	*(0.057)*	*(0.056)*
Firm FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	14,408	14,408	14,408
R-squared	0.922	0.906	0.923

Panel F. Excluding Chinese firms

Dependent Var:	GHGIntensity1&2	GHGIntensity1	GHGIntensity2
	(1)	(2)	(3)
*CBAM Exporter*Post*	-0.101**	-0.096	-0.254***
	(0.046)	*(0.065)*	*(0.070)*
Firm FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	6,687	6,687	6,687
R-squared	0.950	0.939	0.937

Panel G. Excluding Countries with Relatively Small Number of Observations

Dependent Var:	GHGIntensity1&2	GHGIntensity1	GHGIntensity2
	(1)	(2)	(3)
*CBAM Exporter*Post*	-0.097**	-0.071	-0.230***
	(0.042)	*(0.059)*	*(0.057)*
Firm FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	15,839	15,839	15,839
R-squared	0.919	0.903	0.923