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A SYSTEMATIC LITERATURE REVIEW ON THE EFFECTS OF THE EU CARBON BORDER ADJUSTMENT MECHANISM (CBAM) ON INTERNATIONAL TRADE

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Abstract: This study examines how the European Union's Carbon Border Adjustment Mechanism (CBAM) is assessed in the academic literature with respect to its implications for international trade. Employing a systematic literature review (SLR) methodology the study synthesises findings from 32 peer-reviewed journal articles and institutional reports published between January 2020 and July 2024. The review reveals a pronounced asymmetry in the literature. While a limited number of studies frame CBAM as a necessary instrument to prevent carbon leakage and safeguard the EU's climate ambition, the dominant body of research identifies significant economic, legal, and distributive risks. These include potential global welfare losses, heightened risks of trade disputes and retaliation, legal uncertainty regarding compatibility with World

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Trade Organization (WTO) rules, and disproportionate burdens on developing, least developed, and small island economies despite their minimal contribution to historical greenhouse gas emissions. Across disciplinary perspectives, scholars frequently emphasise that CBAM's unilateral design constitutes a central source of legitimacy and equity concerns, as it conflicts with the cooperative foundations of international climate governance. Overall, the literature suggests that, in its current form, CBAM is more likely to operate as a trade-regulating instrument with limited environmental additionality rather than as an effective global climate solution. The review therefore highlights the need for more cooperative and inclusive climate–trade frameworks that incorporate differentiation, revenue recycling, climate finance, and technology transfer. The study concludes by outlining key policy implications and research gaps as CBAM moves from regulatory design toward full implementation.

Keywords: Carbon Border Adjustment Mechanism (CBAM), Carbon Leakage, Climate Policy, International Trade, Trade and Environment.

AB SINIRDA KARBON DÜZENLEME MEKANİZMASININ (SKDM) ULUSLARARASI TİCARETE ETKİLERİ ÜZERİNE SİSTEMATİK BİR LİTERATÜR İNCELEMESİ

Öz: Bu çalışma, Avrupa Birliği'nin Sınırda Karbon Düzenleme Mekanizmasının (SKDM) uluslararası ticaret üzerindeki etkilerinin akademik literatürde nasıl değerlendirildiğini incelemektedir. Çalışmada, sistematik literatür incelemesi (SLR) yöntemi kullanılarak, Ocak 2020–Temmuz 2024 döneminde yayımlanan 32 hakemli akademik makale ve kurumsal raporun bulguları sentezlenmiştir. İnceleme, literatürde belirgin bir asimetri bulunduğunu ortaya koymaktadır. Az sayıda çalışma SKDM'yi karbon kaçağını önlemek ve Avrupa Birliği'nin iklim hedeflerini korumak için gerekli bir araç olarak sunarken, literatürün baskın bölümü mekanizmanın önemli ekonomik, hukuki ve dağıtımsal riskler barındırdığını belirtmektedir. Bu riskler arasında potansiyel küresel refah kayıpları, ticaret ihtilafları ve misilleme risklerinin artması, Dünya Ticaret Örgütü (DTÖ) kurallarıyla uyumluluğa ilişkin hukuki belirsizlikler ile tarihsel sera gazı emisyonlarına katkısı sınırlı olmasına rağmen gelişmekte olan, az gelişmiş ve küçük ada ekonomileri üzerindeki orantısız yükler yer almaktadır. Disiplinler arası literatürde, SKDM'nin tek taraflı tasarımının, uluslararası iklim yönetişiminin iş birliğine dayalı temelleriyle çelişmesi nedeniyle meşruiyet ve hakkaniyet sorunlarının olduğu vurgulanmaktadır. Genel olarak literatür, mevcut hâliyle SKDM'nin etkili bir küresel iklim çözümünden ziyade, çevresel katkısı sınırlı bir ticaret düzenleme aracı olarak işlev

görme ihtimalinin daha yüksek olduğuna işaret etmektedir. Bu nedenle inceleme; farklılaşma, gelir geri dönüşümü, iklim finansmanı ve teknoloji transferini içeren daha iş birliğine dayalı ve kapsayıcı iklim–ticaret çerçevelerine duyulan ihtiyacı ortaya koymaktadır. Çalışma, SKDM'nin düzenleyici tasarımdan tam uygulamaya geçiş sürecinde ortaya çıkan temel politika çıkarımları ve araştırma boşluklarını ortaya koyarak sonuçlandırılmaktadır.

Anahtar Kelimeler: Sınırda Karbon Düzenleme Mekanizması (SKDM), Karbon Kaçağı, İklim Politikası, Uluslararası Ticaret, Ticaret ve Çevre.

INTRODUCTION

Climate change represents one of the most pressing global challenges of the twenty-first century, with implications that extend beyond the environmental domain into economic stability, social cohesion, and international security. Rising global temperatures, accelerating glacier melt, and sea-level rise demonstrate that climate change is no longer a distant risk but an unfolding reality (NASA, 2024). In response, international efforts have intensified, most notably through the Paris Agreement, which established the long-term objective of achieving net-zero greenhouse gas (GHG) emissions by mid-century. However, despite widespread commitments, implementation gaps remain substantial. These gaps are partly explained by the limited enforceability of international climate obligations, uneven domestic capacities, and persistent incentives for emissions-intensive production to relocate to jurisdictions with laxer climate constraints.

Within this context, the European Union (EU) has emerged as a frontrunner in climate policy. Through the European Green Deal and the Emissions Trading System (EU ETS), the EU has adopted binding decarbonization targets and market-based regulatory instruments intended to internalize the cost of carbon. Yet, as the EU strengthens its internal carbon constraints, a core political and economic concern intensifies: carbon leakage. Carbon leakage can occur when stringent climate policies increase production costs domestically, encouraging firms to shift production abroad or causing imports from less-regulated jurisdictions to displace EU production. The result is a dual problem—reduced competitiveness for EU producers and, crucially, limited or even negative net global emissions reductions.

The EU has long positioned itself as a leader in environmental governance, most notably through the early implementation of the EU Emissions Trading System (ETS) in 2005, which applies the polluter-pays principle to emissions-intensive and trade-

exposed sectors accounting for around 40% of EU emissions. While several studies highlight the ETS's contribution to emissions reductions and its role as a cornerstone of the EU's green transition (Bellora & Fontagné, 2023; Bayer & Aklin, 2020), others question its global effectiveness, arguing that production relocation may have limited net emissions reductions at the global level (Allevi et al., 2017).

One of the most controversial extensions of the EU's approach is the Carbon Border Adjustment Mechanism (CBAM), formally introduced in 2021 and scheduled for full implementation in 2026. CBAM aims to prevent carbon leakage by imposing a carbon price on selected imports equivalent to that faced by EU producers under the EU ETS. In principle, CBAM seeks to align the carbon cost embedded in imported goods with the carbon cost faced by EU producers, thereby limiting incentives for production relocation and discouraging "free-riding" on EU climate ambition.

While CBAM is designed as a climate instrument, its implications reach far beyond environmental governance. Given the deep interdependence of global production and trade networks, any border-based environmental tax has direct consequences for international trade, competitiveness, and global welfare. In practice, CBAM raises complex questions about measurement and verification of embedded emissions, administrative feasibility, differential treatment of exporters, and the distribution of costs across countries at different levels of development. It also intersects with fundamental principles of international economic law, including non-discrimination, national treatment, and the balance between environmental objectives and market access commitments.

As a result, CBAM has rapidly become a focal point of academic, legal, and policy debates. The literature spans economics (welfare effects, leakage mitigation, trade diversion), international law (WTO compatibility, proportionality, justification under environmental exceptions), and political economy (retaliation risks, climate club dynamics, governance legitimacy). Despite the growing volume of studies no comprehensive systematic literature review (SLR) has yet focused specifically on CBAM's implications for international trade. This creates a significant gap in the literature at a time when CBAM is transitioning from proposal to implementation.

The trade–environment nexus has been widely examined in the literature from theoretical, empirical, and review-based perspectives. Foundational studies such as Copeland and Taylor (2001) and Williams (1993) develop general frameworks linking trade liberalisation and environmental regulation but predate the emergence of border carbon adjustment mechanisms and therefore do not address carbon pricing at the border as a trade policy instrument. Similarly, Condon and Ignaciuk (2013) review early

border adjustment proposals without analysing the EU's CBAM as an implemented regulatory framework.

More recent systematic reviews (e.g. Balogh and Jámbor, 2020; Balogh and Mizik, 2021; Barrie and Schröder, 2022; Barros and Martínez-Zarzoso, 2022) examine sustainability, agriculture, or circular economy transitions in international trade but do not focus on CBAM-specific trade effects, legal disputes, or distributive outcomes. Other studies address carbon leakage or emissions trading in domestic or sectoral contexts (e.g. Allevi et al., 2017; Bayer and Aklin, 2020) without engaging with border measures.

While Zhong and Pei (2024) provide an overview of CBAM-related developments, their analysis is not centred on international trade impacts. Against this background, the present study differentiates itself by systematically reviewing how the literature assesses CBAM's implications for international trade, thereby offering a focused and policy-relevant synthesis.

Accordingly, the central research question guiding this study is:

RQ: How does the current academic literature assess the potential implications of the EU's Carbon Border Adjustment Mechanism for international trade?

To address this question, this study conducts a systematic literature review of 32 peer-reviewed articles and institutional reports, analyzing both supportive and critical perspectives on CBAM. By synthesizing these findings, the study aims to clarify dominant academic positions, identify areas of convergence and disagreement, and derive policy-relevant implications for global trade governance. In doing so, the review also highlights methodological differences across the literature—particularly between legal and model-based economic approaches—and identifies where further evidence will be needed as CBAM enters its full implementation phase.

1. METHODOLOGY

This study adopts a systematic literature review (SLR) methodology to ensure transparency, replicability, and analytical rigor. The review protocol follows the PRISMA 2020 reporting guidance (Page et al., 2021) and standard SLR procedures outlined in the management and information systems literature (Xiao & Watson, 2019). PRISMA is used to document the identification, screening, eligibility, and inclusion stages, while a formal quality appraisal is used to assess the methodological robustness of the final set of included studies.

1. 1. Data Sources and Search Strategy

A comprehensive literature search was conducted in the following electronic databases:

- Web of Science
- Scopus
- Academic Search Complete
- Emerald
- Google Scholar

The selected databases were chosen to ensure comprehensive coverage of high-quality academic literature and policy-relevant studies. Web of Science and Scopus were included due to their extensive coverage of high-impact peer-reviewed journals, while Academic Search Complete and Emerald were used to capture core social science and trade-policy-focused publications. Google Scholar was additionally consulted to identify relevant grey literature and institutional reports.

Search strings were constructed using Boolean operators to capture both CBAM-specific terminology and broader border carbon adjustment concepts. The core Boolean combinations were:

- "carbon border adjustment mechanism" AND "international trade"
- "CBAM" AND "trade"
- "carbon tax" AND "border adjustment" AND "trade"

Where database functions permitted, searches were expanded using related keywords (e.g., "border carbon adjustment", "carbon leakage", "WTO", "embedded emissions") to improve recall. The final search was completed in July 2024, establishing a clear temporal boundary for the evidence base. This boundary supports replicability and clarifies those publications emerging after this date fall outside the defined scope of the review.

1. 2. Inclusion and Exclusion Criteria

Inclusion and exclusion criteria were applied to ensure the relevance and quality of the reviewed studies, acknowledging limitations related to language, time frame, and publication type, in line with established systematic review practices (Bettany-Saltikov, 2010).

Only studies meeting the following inclusion criteria were retained:

- Language: English
- Publication period: January 2020 – July 2024
- Peer-reviewed journal articles or reports by reputable international,

governmental, or research institutions

• Direct relevance to CBAM and international trade (trade flows, competitiveness, welfare, WTO/legal compatibility, or distributive impacts)

The following were excluded:

• Publications prior to 2020
• Non-peer-reviewed sources lacking institutional credibility
• Items with only tangential relevance to CBAM (e.g., climate policy without a border adjustment component)
• Narrow sector-specific case studies without trade implications (unless generalisable)
• Bilateral trade studies that did not engage with CBAM mechanisms, design, or comparable border adjustment logic

1. 3. Screening Process

The initial search yielded 335 records. Duplicate records were removed prior to screening. Title screening excluded 173 records that clearly fell outside scope. Abstract screening removed an additional 40 records. Full-text screening of the remaining 105 studies resulted in the exclusion of 73 papers that did not meet the inclusion criteria, leaving a final dataset of 32 studies. The study follows the PRISMA reporting guidelines, and the selection process of the reviewed studies is illustrated using a PRISMA flow diagram (Page et al., 2021). (Figure).

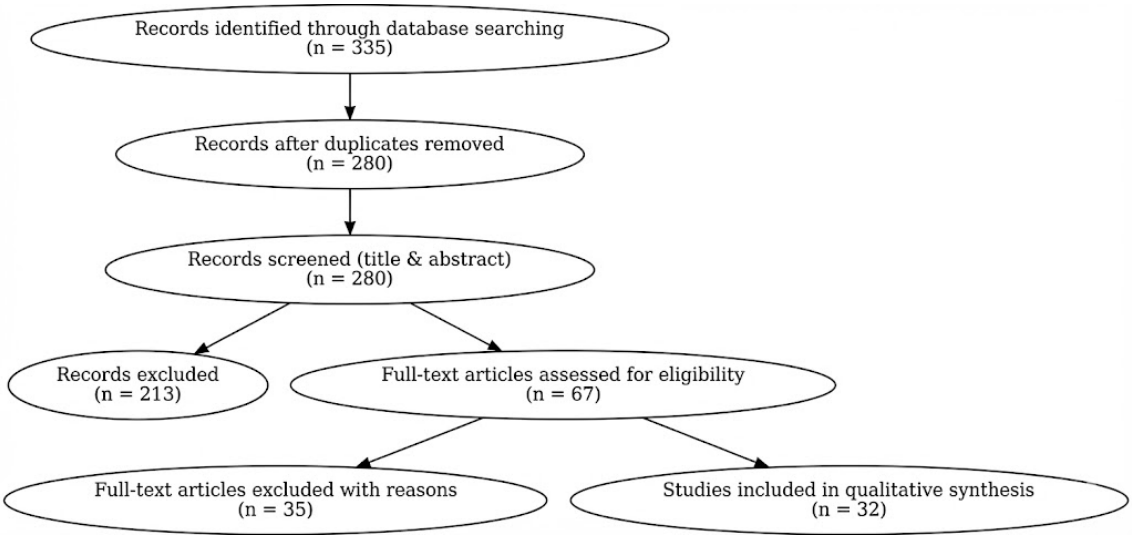

Figure: PRISMA 2020 flow diagram summarizing the study selection process (Page et al., 2021).

1. 4. Quality Appraisal (CASP)

The methodological quality of the included studies was assessed using the Critical Appraisal Skills Programme (CASP) checklist (CASP, 2018). Each study was

evaluated across ten criteria covering research clarity, methodological rigor, data validity, analytical coherence, transparency of assumptions, and policy relevance. Studies were classified as:

- High quality (8–10 points)
- Moderate quality (5–7 points)
- Low quality (below 5 points)

Only high- and moderate-quality studies were included in the final synthesis. A summary of the quality appraisal is provided in the Appendix, enabling readers to verify the review's quality assurance approach without overburdening the main text.

1. 5. Data Analysis and Synthesis Strategy

A narrative and thematic synthesis approach was employed to integrate findings across methods and disciplines. Studies were first grouped into two broad categories:

1. Studies supporting CBAM
2. Studies opposing CBAM

Within each category, findings were coded and synthesised across legal, economic, and political dimensions. Particular attention was paid to (i) how studies conceptualise carbon leakage and competitiveness, (ii) assumptions underlying economic modelling results, (iii) legal reasoning on WTO compatibility and equity principles such as CBDR–RC, and (iv) distributive impacts across developed, developing, and least developed economies. This approach allows comparison of converging and diverging claims while preserving disciplinary nuance. While the literature is organized into supportive and critical parts for analytical clarity, many contributions occupy intermediate or conditional positions.

2. ANALYSIS

Approximately one-third of the reviewed studies portray CBAM as a necessary and legitimate instrument for preventing carbon leakage and reinforcing global climate efforts. Importantly, even within this group, support for CBAM is typically conditional rather than unconditional: authors tend to emphasize that legitimacy and effectiveness depend on design choices, measurement rules, and international responses.

2. 1. Studies Supporting CBAM

From an economic perspective, a first strand of the supportive literature frames CBAM primarily as a carbon leakage prevention instrument. Olasehinde-Williams and Akadiri (2024), using econometric modelling, argue that stringent environmental policies increase leakage risks via trade substitution effects. Their findings suggest that

the welfare and environmental benefits of border carbon adjustments can outweigh trade distortions, particularly if pricing signals encourage cleaner production. However, the result is sensitive to key modelling assumptions regarding price elasticities, pass-through of carbon costs, and the degree to which foreign producers can adjust technologies and input mixes.

Closely related to this argument, a second stream of the literature emphasizes the urgency of climate action and the political infeasibility of broad international agreement. From this view, countries with stricter environmental rules face competitive pressures unless they deploy instruments that push trading partners toward stronger climate policies. Supporters therefore see firm and unilateral measures as necessary. They also challenge the idea that tougher climate policies harm trade, arguing instead that strong environmental action can support trade in the long run by accelerating economic adjustment processes (Böhringer et al., 2022).

Adopting a more strategic perspective, Römer, Schwarz, and Liem (2021) argue that CBAM functions primarily as an external pressure mechanism rather than a direct emissions-reduction tool. In their view, CBAM's greatest leverage lies in incentivizing third countries to adopt domestic carbon pricing or comparable measures in order to preserve access to the EU market. This transforms CBAM into a de facto climate enforcement instrument, although governance remains unilateral and thus vulnerable to legitimacy challenges.

Complementing these production- and strategy-oriented perspectives, Heydenreich (2024) introduces a consumption-based approach by focusing on embedded fossil fuels in EU imports. The study argues that extending CBAM to indirect emissions could strengthen effectiveness, since a considerable share of emissions is embedded upstream in global supply chains. Yet this approach implicitly assumes administrative and measurement capacities that may not exist uniformly across exporting countries, raising concerns about feasibility and the risk of penalizing producers that cannot credibly document product-level emissions.

In addition to economic and strategic considerations, a further group of supportive studies focuses on the legal defensibility of CBAM under international trade law. Krenek (2020) argues that CBAM can be designed to align with GATT tax equivalence principles, provided that imported products are charged in a manner equivalent to domestic carbon costs. However, this reasoning remains contested, as WTO jurisprudence has historically treated process and production methods (PPMs) and the classification of carbon costs as indirect taxes in complex ways. Consequently, legal sustainability depends not only on formal equivalence but also on design details, transparency, and the availability of due process for affected exporters.

Leal-Arcas et al. (2022) similarly argue that accusations of protectionism and discrimination have softened as CBAM design details have become clearer. Yet this claim presumes that transparency alone can resolve deeper structural asymmetries between developed and developing economies—an assumption strongly challenged in the critical literature, particularly where compliance costs and reporting burdens fall disproportionately on exporters with limited administrative capacity.

Finally, some authors situate CBAM within a broader governance framework by conceptualizing it as a potential foundation for a "climate club" architecture. Korpar et al. (2023) acknowledge negative short-term trade effects but emphasize CBAM's coordination potential over time. In this reading, CBAM may accelerate policy convergence by creating incentives for partners to adopt carbon pricing or comparable measures. However, Szulecki et al. (2022) offer a more skeptical interpretation, arguing that CBAM resembles a de facto climate club under EU dominance, where rule-setting authority is concentrated in the European Commission. This raises legitimacy concerns for countries materially affected by CBAM but institutionally excluded from decision-making, reinforcing debates about the boundary between environmental leadership and regulatory power projection.

2. 2. Studies Opposing CBAM

Approximately two-thirds of the reviewed studies adopt a critical stance toward CBAM, arguing that its environmental benefits are limited relative to substantial economic, legal, and distributive costs. This branch of the literature highlights a set of recurring concerns related to welfare outcomes, legal compatibility, and distributional effects across countries with differing levels of development.

A dominant line of the critical literature focuses on global welfare outcomes. Sun et al. (2024), using general equilibrium modelling, demonstrate that unilateral carbon border measures can impose disproportionate GDP losses on least developed economies while delivering negligible global emissions reductions. Their simulations further suggest that cooperative multilateral carbon pricing frameworks outperform unilateral CBAM-type mechanisms in both environmental effectiveness and economic efficiency.

Closely related to this argument, a second layer of critique concerns CBAM's limited environmental effectiveness relative to its trade distortions. Yamano and Guilhoto (2020) show that only a fraction of global emissions is embodied in internationally traded goods. Based on this ceiling, Banga (2022) argues that CBAM is poorly suited as a primary mitigation tool and should be complemented—or partially substituted—by cooperative alternatives such as technology transfer, climate finance,

and production-side decarbonisation support. Collectively, this literature frames CBAM not as a Pareto-improving policy but as a redistributive trade instrument with limited climate additionality.

Beyond welfare considerations, a second major line of opposition focuses on CBAM's legal fragility under WTO law and the political risk of retaliation. Several studies emphasize that CBAM may generate trade conflicts by creating tensions with core principles of international trade law, particularly non-discrimination and national treatment under the WTO framework. Shum (2024) argues that policy responses aimed at offsetting CBAM's domestic impacts—such as subsidizing local producers—may themselves constitute violations of WTO rules, thereby intensifying disputes and retaliation dynamics.

From a political economic perspective, Dominioni and Esty (2023) contend that in the absence of multilateral economic sanctions, unilateral climate policies impose cost disadvantages on domestic producers, rendering mechanisms such as CBAM politically inevitable. However, they stress that CBAM must be carefully designed to avoid functioning as a protectionist tool or a disguised non-tariff barrier, highlighting an inherent tension between climate ambition and the preservation of open trade principles.

Quick (2021) examines whether CBAM is compatible with the GATT framework and argues that, as a novel form of taxation, it raises systemic concerns under multilateral trade law. Beyond GATT compliance, the study contends that CBAM conflicts with the cooperative spirit of the Paris Agreement by overlooking the principle of common but differentiated responsibilities and respective capabilities (CBDR–RC). From this perspective, the current design of CBAM lacks a key equity dimension embedded in international climate governance.

Legal analyses therefore remain divided into CBAM's compatibility with WTO law. Some studies argue that CBAM may be defensible under GATT exceptions related to environmental and human health protection, while acknowledging that counterarguments grounded in the UNFCCC's CBDR–RC principle retain substantial legal weight (Steinhauser et al., 2024). This duality suggests that CBAM's legal status is inherently ambiguous, with plausible arguments available to both proponents and critics.

Hufbauer et al. (2022) highlight several challenges regarding CBAM's compatibility with WTO rules, particularly the risk of discriminatory treatment. They note that while CBAM recognizes explicit carbon prices paid in other countries, it overlooks comparable compliance costs arising from non-market regulatory measures. This asymmetry, the authors argue, may constitute a violation of WTO non-

discrimination principles and increase the likelihood of prolonged trade disputes and retaliatory measures. From a policy perspective, the report emphasizes the need for more inclusive, multilateral approaches to climate mitigation, potentially coordinated through international institutions such as the WTO, OECD, and IMF.

Perceptions among trading partners further complicate this legal and political debate. Lim et al. (2021) characterize CBAM as a potential pitfall for global trade, arguing that despite the EU's framing of the mechanism as a climate policy tool, it is widely perceived as a new form of trade barrier. According to the authors, this perception stems from the EU's discretionary approach to defining and implementing CBAM, which fuels concerns about arbitrariness and undermines trust in its trade neutrality.

Export rebates constitute a particularly contentious aspect of CBAM's trade effects. Leonelli (2022) argues that the EU's consideration of export rebates for firms selling to more carbon-intensive markets risks exacerbating CBAM's trade distortions. While CBAM itself already raises concerns regarding WTO compatibility, the introduction of export rebates may further undermine its consistency with multilateral trade rules by reinforcing perceptions of discrimination and protectionism.

Empirical evidence further complicates this debate. Steinhauser et al. (2024) find that CBAM does not necessarily disrupt trade among high-emission economies. Instead, trading partners may respond by lowering carbon intensity in production to retain access to the EU market rather than withdrawing from trade relations altogether, indicating that CBAM's trade effects are heterogeneous and contingent on countries' adaptive capacities.

Contrary to the domestic protection narrative, several studies argue that CBAM may also weaken EU export competitiveness. Bellora and Fontagné (2023) show that higher carbon prices under the EU ETS can reduce export competitiveness in energy-intensive sectors. Curran and Carrasco-Farré (2024) further suggest that retaliation risks may propagate through value chains, producing second-order contraction effects on EU manufacturing and export-led growth, potentially undermining political sustainability within the EU.

Distributional concerns constitute a further central critique within the opposing literature. Boute (2024) shows that by relying heavily on explicit carbon pricing as a benchmark, CBAM may disadvantage countries that reduce emissions through non-price regulatory instruments, creating incompatibilities with CBDR–RC's differentiation logic. Durán (2023) provides a doctrinal legal analysis indicating that uniform CBAM application across heterogeneous economies can conflict with

environmental equity norms and proportionality principles. The study supports LDC and SIDS exemptions combined with revenue recycling, while acknowledging risks of trade diversion and administrative complexity.

Sasmal et al. (2024) complicate this picture by arguing that permanent LDC exemptions may induce carbon arbitrage and transshipment, illustrating the tension between equity objectives and trade integrity. Perdana and Vielle (2022) further show that LDC export losses under CBAM could generate substantial welfare contractions, making decarbonization fiscally unattainable without meaningful redistribution.

Beaufils et al. (2023) warn that exemptions or exclusions under CBAM may turn non-covered countries into pollution havens, arguing that voluntary inclusion through climate coalitions offers a more effective alternative to unilateral exclusion. Their analysis shows that even a narrowly scoped CBAM is likely to impose significant burdens on developing and vulnerable economies. To address these distributional effects, the authors highlight the importance of revenue recycling schemes as a complementary tool to mitigate adverse impacts.

Eicke et al. (2021) similarly argue that CBAM, despite its stated objective of reducing carbon emissions, poses a significant risk of exacerbating global inequalities by disproportionately affecting trade relations between developed economies and vulnerable countries. To mitigate these distributive effects, it is frequently suggested that revenues generated from CBAM should be channeled toward enhancing the technological and economic capacities of the most affected countries.

A final strand of the critical literature focuses on CBAM's structural design and unilateral character. Mehling and Jakob (2024) argue that CBAM's design is penalty-oriented rather than incentive-compatible, distorting international trade by disproportionately affecting developing economies while also placing pressure on export-oriented sectors within the EU. In this context, international trade rules risk becoming secondary to unilateral climate objectives, potentially encouraging fragmented policy responses.

Even proposals aimed at mitigating these effects face significant limitations. Casarano and Villalta Puig (2024) acknowledge that revenue recycling and financial or technical support mechanisms could improve CBAM's compatibility with WTO rules. Nonetheless, they argue that CBAM's fundamentally imposing and unilateral nature remains incompatible with principles of equality and non-discrimination, characterizing the EU's CBAM as a blunt instrument warranting scrutiny by the WTO Dispute Settlement Body.

Banks and Fitzgerald (2020) similarly warn that border penalties may strengthen protectionist coalitions while delivering weak climate payoffs, advocating reward-based approaches such as tariff reductions for low-carbon producers.

A further line of the literature criticizes CBAM's reliance on a uniform, price-based approach to carbon regulation. Sato (2022) argues that CBAM's monotype design risks increasing, rather than reducing, global carbon emissions by disregarding alternative mitigation strategies employed in other countries. By penalizing regulatory approaches that differ from the EU's carbon pricing model—yet may be equally or more effective—CBAM may incentivize retaliatory measures and fragmented trade responses.

This critique is reinforced by arguments that CBAM's carbon charge on imports from third countries is discriminatory and unfair when it is calculated on the basis of average carbon emissions within the EU. From both an equity perspective and the standpoint of compliance with international trade rules, it is argued that any carbon-related charge should be linked to products' embedded (or "hidden") carbon content, rather than EU-wide production averages (Clora et al., 2023).

In response to these design-related concerns, Mehling and Ritz (2020) propose an alternative framework centered on an individual adjustment mechanism. This approach would allow producers to voluntarily demonstrate their actual carbon intensity, rather than being assessed solely on default benchmarks derived from the EU's regulatory model. They argue that such a mechanism would better align with economic efficiency by directly rewarding lower-emission production practices, thereby offering stronger incentives for genuine emissions reductions.

From this perspective, CBAM may fail to effectively reduce carbon leakage while simultaneously undermining international trade and potentially violating GATT provisions, including exemption-related principles. This critique reinforces concerns that CBAM conflates regulatory heterogeneity with environmental inferiority.

Addressing these concerns, White et al. (2024) propose a set of design principles intended to minimize trade and governance risks associated with carbon border measures. They argue that such mechanisms must strike a careful balance between climate effectiveness and trade integrity, warning that poorly calibrated designs may fail to achieve either objective. Their contribution reinforces the broader conclusion that CBAM's success depends less on its punitive capacity than on its institutional coherence and integration with international trade norms.

CONCLUSION

This systematic literature review assessed 32 academic articles and institutional reports examining how CBAM may affect international trade. The findings indicate a pronounced asymmetry: while a minority of studies defend CBAM as a necessary climate enforcement tool, the dominant scholarly consensus emphasizes substantial risks to trade stability, legal predictability, and distributive justice.

Supportive studies justify CBAM primarily as a response to carbon leakage and as a lever for climate leadership. Yet even these analyses recognize that effectiveness depends on partner convergence, administrative feasibility, and legal tolerance under WTO rules—conditions that remain uncertain and politically contested. By contrast, the critical literature highlights that CBAM may produce global welfare losses, disproportionately burden least developed economies, and embed trade conflict risks through unilateral rule-setting and contested equivalence claims.

For the European Union, the literature suggests that CBAM functions not only as a climate instrument but also as a regulatory intervention with external distributive consequences. Several studies therefore emphasize that border adjustment mechanisms cannot operate in isolation from broader climate and trade governance frameworks. In particular, the literature recurrently highlights the importance of international coordination around carbon pricing or comparable measures, the use of CBAM revenues to support vulnerable exporters through climate finance, and complementary technology transfer aimed at production-side decarbonization. This concern is particularly pronounced for least developed countries (LDCs), which the literature identifies as bearing disproportionate welfare losses unless technology transfer and targeted revenue recycling mechanisms are credibly implemented. Without such accompanying measures, CBAM risks reinforcing existing asymmetries in the global trading system rather than facilitating an equitable low-carbon transition.

In the absence of credible pathways for shared rule-making, the literature suggests that CBAM may evolve into a de facto climate club characterized by asymmetric authority rather than cooperative governance. Overall, the reviewed studies do not reject border carbon adjustments per se, but they consistently caution against unilateral and asymmetrically enforced carbon trade regimes that remain detached from considerations of equity and legitimacy.

Finally, the review identifies several research gaps requiring attention as CBAM approaches full implementation, including post-2026 empirical assessments, firm-level adaptation strategies, export competitiveness impacts, and South–South trade diversion dynamics. Future SLR studies may incorporate emerging evidence from CBAM's

transitional phase, particularly sector- and firm-level reporting data, allowing a clearer distinction between scenario-based modelling and early empirical assessments of CBAM's trade and distributional effects.

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Externally peer-review
Author Contribution
All sections of this study were written by a single author.
Conflict of Interest
The author declares no conflict of interest.
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Appendix

Author(s)	**Year**	**Method**	**Quality**
Banga	2022	Policy commentary	Moderate
Beaufils et al.	2023	Empirical trade modelling	High
Bellora & Fontagné	2023	CGE modelling	High
Boute	2024	Legal & policy analysis	High
Böhringer et al.	2022	Economic modelling	High
Casarano & Villalta Puig	2024	WTO legal analysis	High
Clora et al.	2023	CGE modelling	High
Curran & Carrasco-Farré	2024	NLP-based trade analysis	High
Dominioni & Esty	2023	Governance analysis	High
Durán	2023	Doctrinal legal analysis	High
Eicke et al.	2021	Political economy analysis	High

Heydenreich	2024	Consumption-based analysis	High
Hufbauer et al.	2022	Policy report	Moderate
Korpar et al.	2023	Economic policy analysis	Moderate
Krenek	2020	Legal-policy report	Moderate
Leal-Arcas et al.	2022	Legal analysis	High
Leonelli	2022	WTO legal analysis	High
Lim et al.	2021	Policy critique	Moderate
Mehling & Jakob	2024	Legal-economic analysis	High
Mehling & Ritz	2020	Policy design analysis	High
Olasehinde-Williams & Akadiri	2024	Econometric analysis	High
Perdana & Vielle	2022	CGE modelling	High
Quick	2021	Legal critique	Moderate
Römer et al.	2021	Policy report	Moderate
Sasmal et al.	2024	Legal-economic analysis	High
Sato	2022	Legal analysis	Moderate
Shum	2024	Sectoral analysis	High
Steinhauser et al.	2024	Econometric analysis	Moderate
Sun et al.	2024	General equilibrium modelling	High
Szulecki et al.	2022	Political economy analysis	Moderate
White et al.	2024	Methodological analysis	High
Yamano & Guilhoto	2020	Policy report	Moderate