LUISS

Course of

SUPERVISOR

CO-SUPERVISOR

CANDIDATE

Academic Year

Table of Contents

List of Abbreviations

ACP	African, Caribbean and Pacific (countries)
APEC	Asia-Pacific Economic Cooperation
API	Application Programming Interface
ATMs	Autonomous Trade Measures
BMZ	German Federal Ministry for Economic Cooperation and Development
CBAM	Carbon Border Adjustment Mechanism
CIF	Cost, Insurance and Freight
CN	Combined Nomenclature (EU goods classification)
CO_2	Carbon dioxide
COP26	26th Conference of the Parties (UN climate conference)
CRI	Costa Rica (ISO-3 country code)
DCFTA	Deep and Comprehensive Free Trade Area (EU–Ukraine)
EEAS	European External Action Service
EPA	Economic Partnership Agreement
EU	European Union
EU–RoW	European Union vs Rest of World benchmark/comparison
EVFTA	EU–Vietnam Free Trade Agreement
EVN	Electricity of Vietnam
FONAFIFO	Costa Rica's National Forestry Financing Fund
FOB	Free On Board
FTA	Free Trade Agreement
GHA	Ghana (ISO-3 country code)
GHG	Greenhouse Gas
GIZ	German development agency
HS	Harmonised System (goods classification)
HS2 / HS4 / HS6	Harmonised System product codes at 2-/4-/6-digit level
JETP	Just Energy Transition Partnership
MINAE	Costa Rica Ministry of Environment and Energy
MRIO	Multi-Regional Input–Output
MRV	Measurement, Reporting and Verification
MWp	Megawatt-peak
ND-CP	Vietnamese Government decree numbering suffix
OEC	Observatory of Economic Complexity
PDP7	Vietnam Power Development Plan VII
PES	Payment for Ecosystem Services
PTA	Preferential Trade Agreement
QH14	Vietnam National Assembly XIV
QĐ-TTg	Vietnamese Prime Minister Decision numbering suffix

RoW	Rest of World (non-EU destinations)
TSD	Trade and Sustainable Development
TREND	Trade and Environment Database
UKR	Ukraine
UN	United Nations
US	United States
USD	US dollar
USITC	United States International Trade Commission
VNM	Vietnam
WITS	World Integrated Trade Solution (World Bank)
EU-bound	exports destined to the EU
EU-facing	oriented toward EU market/regulatory conditions
non-EU	destinations outside the EU (often treated as RoW)

List of Figures

List of Tables

Unless stated otherwise, all figures and tables are based on UN Comtrade data and report the author’s own calculations.

1. Introduction

Europe’s climate ambitions increasingly depend on outcomes beyond its borders. As the European Union (EU) seeks to decarbonise its economy, it remains deeply embedded in global supply chains for emissions-intensive upstream goods (European Commission, 2019). This creates a core governance tension: even if emissions fall within the EU, global climate outcomes depend on how production and trade adjust in partner countries. In response, the EU has begun to link market access more explicitly to environmental standards through two complementary instruments. First, it has systematically integrated environmental objectives into preferential trade agreements (PTAs) via Trade and Sustainable Development (TSD) chapters and related governance mechanisms (European Commission, 2022). Second, the Carbon Border Adjustment Mechanism (CBAM) extends climate conditionality to selected upstream sectors through embedded-emissions reporting and, from 2026, financial liability following a transitional reporting period (EU Council and EU Parliament , 2023; European Commission, 2026a). Together, these instruments reflect an attempt to leverage market size to support decarbonisation in supply chains.

Theoretically, it is ambiguous whether EU trade governance delivers environmental improvement. While trade liberalisation can increase output and trade volumes, including in emissions-intensive sectors, sustainability provisions aim to shift trade towards cleaner products and, in the long term, towards cleaner production methods. A central risk is that the apparent 'greening' of EU-bound exports reflects destination-specific reallocation rather than upgrading across the entire economy: exporters may supply cleaner products to the EU while maintaining or increasing emissions-intensive exports to non-EU markets. This distinction is important for climate policy because reallocation can generate outcomes consistent with diversion or leakage, even when EU trade appears to be greener.

Existing research provides important evidence that environmental provisions in PTAs are associated with a more environmentally friendly composition of bilateral exports (Brandi et al., 2020; Baghdadi, Martinez-Zarzoso and Zitouna, 2013). However, much of this literature focuses on bilateral trade with partner markets, limiting its ability to distinguish EU-specific sorting from broader changes in a country's overall export structure. Even if EU-bound exports become cleaner, it is unclear whether 'dirty' exports would contract overall or be redirected to alternative destinations. This motivates a comparative approach between destinations that benchmarks EU-bound exports against exports to the rest of the world (RoW).

The aim of this thesis is to fill this gap by investigating how EU trade agreements are associated with changes in the environmental composition of exports from partner countries, and are these changes systematically different for exports to the EU compared to exports to the rest of the world? The empirical analysis is based on HS6 trade data to construct annual country-level outcomes for the period 2010–2024, and employs two policy-relevant baskets: 'dirty' goods, proxied by the sectoral scope of the Carbon Border Adjustment Mechanism

(CBAM); and 'green' goods, proxied by a standard environmental goods classification, the APEC List of Environmental Goods. The key empirical indicator is the EU–RoW composition gap, which reveals whether the EU receives a different basket of goods compared to other destinations, and whether this changes around the time of agreement implementation.

Four case studies are used to examine heterogeneity under different scope conditions: Costa Rica, Vietnam, Ghana and Ukraine. Structured EU–RoW benchmarking is combined with deeper within-case interpretation where mechanism tracing is feasible. The core argument is that EU PTAs primarily operate as enabling governance frameworks, raising the salience and predictability of EU-facing sustainability expectations and supporting destination-specific adjustment, particularly in compliance-intensive 'green' niches. However, agreements do not impose immediate carbon constraints on upstream industrial goods and compositional improvement can coexist with scale expansion in emissions-intensive sectors when binding carbon costs lag behind market opening. The thesis therefore clarifies the circumstances in which EU green trade governance is associated with EU-facing compositional change and the areas in which its limitations are most evident.

The remainder of the thesis proceeds as follows: Chapter 2 provides a contextualisation of the project within the literature on green trade governance, the Brussels Effect, and carbon leakage. Chapter 3 outlines the comparative research design and the development of the HS6-based EU–RoW indicators. Chapter 4 presents descriptive baseline evidence on export composition and EU exposure during the period prior to the agreement. Chapter 5 reports the main cross-case findings and evaluates scope conditions, including comparative assessments of Ghana and Ukraine. Chapter 6 then provides dedicated case-study analyses, offering in-depth insights into Costa Rica and Vietnam. Chapter 7 draws out the broader implications for EU trade policy and climate governance. Chapter 8 provides a conclusion.

2. Background and working hypotheses

2.1 Trade agreements, environmental provisions, and developing-country adjustment

A growing body of political economy literature treats preferential trade agreements (PTAs) not only as instruments for reducing tariffs, but also as governance arrangements that influence domestic regulation and production patterns (Baghdadi, Martinez-Zarzoso & Zitouna, 2013; Bastiaens & Postnikov, 2017; Brandi, Bruhn & Morin, 2019; Kolcava, Nguyen & Bernauer, 2019; Martinez-Zarzoso & Oueslati, 2016; Hofmann, Osnago and Ruta, 2018; Dür, Baccini and Elsig, 2013). Within this strand of literature, environmental provisions and Trade and Sustainable Development (TSD) chapters have become a central focus of study. The EU is a particularly important actor in this regard, having systematically incorporated environmental considerations into its trade policy and invested in codifying sustainability objectives[1] across agreements (Morin, Dür, & Lechner, 2018; European Commission, 2022).

At the same time, standard trade-environment theory suggests that the net environmental impact of liberalisation is ambiguous by definition. Reduced trade barriers can increase environmental pressure due to a scale effect, as cheaper market access leads to increased output and trade volumes. However, liberalisation can also generate cleaner outcomes through composition effects, such as specialisation shifts towards less pollution-intensive activities, and technique effects, such as cleaner production methods induced by regulation, technology diffusion or income-related demand for environmental quality. Grossman and Krueger (1991) popularised this decomposition in the context of trade, and Copeland and Taylor (2004) synthesised the broader theoretical and empirical debate, including the pollution haven hypothesis and the role of differences in environmental policy in shaping trade patterns. The key implication for this thesis is that PTAs that deepen market access may mechanically stimulate both clean and dirty exports, unless environmental governance becomes sufficiently credible and costly to override the scale effect.

In principle, environmental provisions in PTAs can tilt the balance towards greener outcomes by raising the expected cost of environmentally harmful production and stabilising regulatory direction. In the EU context, TSD chapters explicitly promote environmental protection and support the implementation of partner countries through dialogue, institutionalised monitoring and cooperative tools. Recent EU policy emphasises stronger implementation and enforcement efforts (European Commission, 2026b). In line with this, empirical research suggests that environmental provisions are linked to changes in the composition of bilateral exports. Brandi et al. (2020) demonstrate that developing countries that sign PTAs containing environmental provisions tend to reduce exports of 'dirty' goods and increase exports of 'green' goods in bilateral trade, with the effects being stronger where domestic environmental regulation is already relatively stringent. This suggests that the commitments made in the agreements interact with domestic capacity and baseline policy conditions rather than operating as automatic 'greening devices'.

However, a second strand of literature highlights why environmentally 'deep' agreements may also generate trade-offs, particularly in South–North trade. Environmental provisions can raise fixed and variable costs for exporters through compliance-relevant governance, particularly when production upgrades, certification and documentation are required to maintain access to high-income markets. Berger et al. (2020) provide evidence consistent with this, finding that PTAs with more environmental provisions are associated with lower bilateral trade between partners than PTAs with fewer such provisions. This negative association is driven by South–North flows[2]. Rather than negating the concept of 'greening',

---

[1] TSD chapters in EU FTAs usually combine environmental and labour commitments, monitored via joint committees and civil-society bodies; enforcement is mainly consultative/panel-based rather than sanctions.

[2] i.e. exports from developing countries to high-income countries

this 'cost of compliance' logic clarifies that the adjustment margin can involve both changes in composition and constraints on market participation, and that the effects may differ by sector, exporter capability, and time horizon.

Taken together, this body of literature highlights a key contradiction that has shaped the design of the thesis. While the existence of environmental provisions and TSD governance could generate incentives for greener exports facing the EU, tariff liberalisation and predictable market access could simultaneously expand industrial exports, including emissions-intensive upstream goods, when environmental constraints are delayed, weakly enforced or not yet economically binding. In such circumstances, changes observed in exports to the EU may reflect a combination of the following: (i) compositional adjustment facing the EU (consistent with regulatory expectations and demand for 'green' goods); (ii) expansion in scale (an increase in overall industrial exports); and (iii) reallocation of destinations (including the possibility that emissions-intensive output is redirected to non-EU markets rather than being reduced). For a recent overview of how trade and environmental policies interact through these channels, see Felbermayr, Peterson and Wanner (2024).

As much of the existing evidence focuses on EU–partner trade, it offers little insight into whether apparent 'greening' reflects broader upgrading or merely the re-sorting of product bundles across destinations.This limitation underpins the EU–rest-of-world benchmarking strategy adopted by the thesis, which is designed to distinguish EU-specific adjustments from global trends affecting both EU and non-EU markets simultaneously.

Although the theoretical effects are multifaceted, Hypothesis 1 tests the primary expectation found in the TSD literature, namely that the regulatory signal of the agreement is sufficient to encourage EU-facing greening of the export basket.

Hypothesis 1 (EU-facing adjustment): After an EU trade agreement comes into force, the proportion (and/or value) of 'dirty' exports to the EU will decrease, while 'green' exports to the EU will increase.

2.2 EU market power and the Brussels effect Regulation without formal enforcement

The 'Brussels effect' is a mechanism through which EU rules and standards can influence the behaviour of firms beyond the EU's borders, even in the absence of direct enforcement. Bradford (2015, 2020) argues that the combination of the EU's market size, regulatory capacity and stringent rules creates incentives for firms to align with EU requirements when access to the EU market is economically important, and maintaining separate compliance regimes is costly. Damro (2012) supplements this perspective with a political-economic analysis, conceptualising the EU as 'Market Power Europe': the EU's substantial internal market and regulatory institutions enable it to extend its rules through market mechanisms rather than coercion or formal enforcement.

In this thesis, EU trade agreements are not primarily considered to be instruments that enforce environmental rules through litigation or sanctions. Rather, they are considered to be mechanisms that enhance the credibility and visibility of EU sustainability expectations. By incorporating sustainability language, institutionalised dialogue, transparency provisions and regulatory cooperation, EU PTAs can render EU standards, and the prospect of future tightening, more predictable and salient for exporters and EU buyers (European Commission, 2026b). This increases the expected benefits of complying with and investing in EU standards, even when formal dispute enforcement is rarely used. In this sense, PTAs can strengthen the conditions under which a 'Brussels effect'-type response emerges by stabilising expectations and reducing uncertainty around the EU-facing policy environment.

Building on Bradford's (2015, 2020) work, the thesis distinguishes between a strong and a weak Brussels Effect, considering them to be two analytically distinct outcomes with different empirical signatures. A strong Brussels Effect implies broader convergence, whereby firms upgrade production and compliance in ways that extend beyond the EU market. This occurs either because a single standard is cheaper than segmentation, or because domestic regulation and capabilities adjust in parallel. In contrast, a weak Brussels Effect implies destination-based adjustment: firms segment markets and allocate more compliant or 'cleaner' product bundles towards the EU, while maintaining other bundles for non-EU destinations. This distinction is central to the research design of the thesis because it suggests that analyses focusing solely on the EU may exaggerate the extent of upgrading across the entire economy.

The likelihood of strong versus weak effects depends on the characteristics of the sector and technology. In many climate-relevant sectors, carbon intensity is tied to process and production methods rather than to observable final-product traits. This can make universal convergence more difficult and market segmentation easier. Notably, segmentation does not necessitate 'two versions' of the same final product; it can be achieved through intra-firm reallocation — making choices at the plant level, supplier selection, documentation efforts and shipment allocation (Mayer, Melitz and Ottaviano, 2014; Bastos and Silva, 2010). For instance, output from cleaner or better-documented production could be directed towards the EU, while other output could be directed towards destinations with less stringent or less salient requirements. In such settings, incentives facing the EU can alter the composition of destinations without implying uniform changes in overall production.

From a trade-environment perspective, this market-segmentation logic is closely linked to the literature on carbon leakage. Carbon leakage occurs when emissions-intensive production and trade are displaced from more regulated to less regulated settings through competitiveness and trade channels. If the cost (or perceived risk) of selling emissions-intensive goods to the EU increases due to EU-facing pressure, exporters may reallocate the distribution of such goods rather than reducing emissions-intensive output globally. In this sense, EU market power and leakage are complementary rather than competing explanations. EU-facing incentives could encourage cleaner exports to the EU while preserving or reallocating emissions-intensive production elsewhere. Felbermayr and Peterson (2020) provide an overview of leakage mechanisms and evidence, while Aichele and Felbermayr (2015) document patterns consistent with leakage in trade-based measures. This thesis operationalises these mechanisms using a benchmark of the EU versus the rest of the world. Empirically, a weak Brussels Effect (based on destinations) should be evident in compositional differences between the EU and non-EU markets, which motivates the use of an EU–RoW benchmark in the analysis.

Hypothesis 2 (destination gap consistent with a weak Brussels Effect and carbon leakage risk): Following the implementation of an EU trade agreement, the dirty share of exports destined for the EU declines relative to the dirty share of exports destined for the rest of the world. This causes the EU–RoW dirty composition gap to move in the 'clean' direction (becoming more negative).

2.3 Agreement design and the role of environmental provisions

In addition to the size of the EU market and its regulatory capacity, political economy research emphasises that the design of preferential trade agreements (PTAs) influences the extent to which sustainability objectives are translated into real-world incentives. 'Depth' is commonly understood to refer not only to tariff coverage, but also to the breadth and institutionalisation of provisions that structure regulatory cooperation, transparency, monitoring and dispute settlement procedures across a wider set of policy areas. Deep PTAs therefore differ systematically in how far they establish ongoing governance relationships that extend beyond border measures (Hofmann, Osnago and Ruta, 2018; Dür, Baccini and Elsig, 2013).

In order to compare the environmental dimension of agreement design, the thesis uses the Trade and Environment Database (TREND), which categorises environmental provisions in the complete texts of a large number of PTAs. In line with the work of Morin, Dür and Lechner (2018), this thesis employs the aggregate count of environmental provisions as a straightforward and comparable indicator of the extent to which environmental governance is embedded within an agreement's structure.

Crucially, a higher density of environmental provisions does not automatically imply immediate, binding constraints. Instead, agreements with a high density of provisions can operate as credibility and salience devices. They can institutionalise dialogue (e.g. through committees and work programmes), create transparency and consultation routines, and expand monitoring by stakeholders, thereby serving as a credible commitment that reduces uncertainty for exporters (Mansfield and Milner, 2012; Brunner, Flachsland and Marschinski, 2012; Gulen and Ion, 2016). This makes EU-facing sustainability expectations more visible and predictable for exporters and buyers, even when formal litigation is rare. This is consistent with institutional design research showing that 'soft law' can shape expectations and reduce uncertainty despite weaker enforceability, and political economy work arguing that international trade agreements can function as credible commitments that reassure external actors because reneging is costly (Abbott and Snidal, 2000; Büthe and Milner, 2008; Guzman and Meyer, 2010; Mayer, 2016). It also aligns with the way in which the EU itself describes the implementation of Trade and Sustainable Development (TSD) governance through institutionalised monitoring structures (including domestic advisory groups), as well as strengthened implementation and enforcement strategies (European Commission, 2026b).

Accordingly, agreement depth is treated as a *scope condition* rather than a sufficient cause. More comprehensive environmental governance should strengthen EU-facing incentives for adjustment, but the extent to which this translates into observable shifts in export composition remains conditional on partners' baseline export structures, EU exposure in the relevant sectors, and the timing and credibility of 'hard' constraints.

Hypothesis 3 (agreement depth and commitment quality): Trade agreements with broader and more comprehensive environmental provisions are associated with stronger shifts away from 'dirty' exports and towards 'green' exports in EU-bound trade.

2.4 Time horizon: Short-term sorting versus long-term upgrading

Adjustment to trade agreements is inherently dynamic because firms can respond in different ways, at different speeds and at different costs. In the short term, exporters can change where they sell and which products they allocate to different destinations without fundamentally changing the way they produce goods (Mayer, Melitz and Ottaviano, 2014; Bown and Crowley, 2007). In contrast, sustained 'upgrading' of output, especially when involving cleaner technologies, new capabilities or compliance systems, typically requires investment, learning and coordination along supply chains, which unfold over longer timeframes (Lileeva and Trefler, 2010; Alessandria, Choi and Ruhl, 2021).

A large body of literature on firms' trade activities explains why short-term responses are dominated by reallocation. When exporting involves sunk entry costs and market-specific fixed costs, firms tend to persist in their participation in the market. Entry and expansion then occur gradually as firms learn about demand and profitability, or gradually recover the initial costs of market entry (Das, Roberts and Tybout, 2007). More generally, exporters are often multi-product firms that can adjust relatively quickly by adding and dropping products, and by reshuffling their product mix across markets. This 'product switching' and shipment reallocation can generate noticeable compositional change even when underlying production technology changes little in the short term (Bernard, Redding and Schott, 2010). Recent trade models also emphasise that the transition path matters. Following liberalisation, new exporters typically begin with a small presence in export markets, growing over time. This implies that the full adjustment to a policy change may take years rather than being immediately apparent in annual aggregates (Alessandria, Choi and Ruhl, 2021).

The timeframe for adjustment is also influenced by credibility and uncertainty. Preferential trade agreements can influence behaviour by altering applied tariffs and reducing uncertainty regarding future market access. When firms face sunk export costs, uncertainty creates an 'option value of waiting', and credible agreements can encourage gradual market entry and investment by providing greater predictability regarding future access (Handley and Limão, 2015). This is an important consideration for sustainability-oriented adjustments: if environmental commitments are perceived as signals of future tightening (even when enforcement is initially lenient), firms may initially respond through destination sorting, allocating more compliant output to the EU, while deeper changes in technology or input use will occur later, provided that these signals are persistent and credible.

Over longer time periods, compositional change is more likely to reflect investment and capability development than mere reallocation. Complementary literature shows that improved, stable market access can encourage firms to upgrade technology, innovate and increase productivity, particularly among those for whom the fixed costs of upgrading only become profitable when export opportunities expand (Bustos, 2011). These mechanisms imply that the 'greening' of export baskets, especially in sectors where compliance is costly, may emerge with a delay, which is consistent with the idea that trade agreements can establish incentives immediately while production structures only adjust gradually.

This dynamic perspective explains the empirical focus on timing in the thesis. Differences in export composition between the EU and RoW may react relatively quickly if firms reallocate shipments and product lines across destinations. However, broader changes in overall export composition are likely to be slower because they require investment cycles, learning and the accumulation of compliance capabilities. The gradual impact of agreements is also consistent with evidence from gravity-based studies indicating that the trade effects of FTAs tend to increase over time rather than becoming apparent fully within the first years after coming into force (Baier and Bergstrand, 2007). This distinction is particularly relevant when comparing newer agreements (e.g. the EVFTA/DCFTA) with longer-standing arrangements (e.g. Costa Rica’s Association Agreement).

Hypothesis 4 (time): The EU–RoW gap in export composition emerges relatively quickly after entry into force (sorting/diversion), while broader changes in overall export composition, if they occur, only become apparent over a longer time horizon.

3. Research Design and Data

Section 3 outlines how the thesis pinpoints EU-specific shifts in export composition and connects these patterns to the research questions. This process involves three steps. First, Section 3.1 justifies the selection of Vietnam, Ukraine, Ghana, and Costa Rica, and sets out the comparative logic. Each case is analysed through a nested comparison[3] of exports to the EU versus exports to non-EU destinations (RoW) before and after the effective start year of the agreement. This nested design incorporates two levels of benchmarking: within each case, the outcomes for the EU are evaluated against the RoW counterfactual in order to distinguish EU-specific adjustments from broader global trends. Across cases, the differences in the depth of the agreements, the baseline export structures, and the exposure to shocks are used to explain why the patterns of the EU and RoW diverge between countries. Additionally, the thesis includes two in-depth case studies of Costa Rica and Vietnam that complement the aggregate benchmarking with HS6-level diagnostics and a brief policy timeline, enabling the discussion to progress from documenting patterns to interpreting potential mechanisms.

Section 3.2 outlines the data sources and the construction of the main variables. Using UN Comtrade's product-level trade values (HS6) from 2010 to 2024, the thesis calculates destination-specific measures of 'dirty' exports (i.e. CBAM-scope product categories), 'green' exports (i.e. environmental goods) and total trade. It then derives trade shares, EU–RoW composition gaps and diversion-oriented indicators. The HS6 structure also facilitates the product-level components of the in-depth analysis, including the identification of the HS6 lines that drive pre/post shifts, and diagnostics that distinguish EU-facing sorting from broader changes in the global export basket. Section 3.3 outlines the empirical strategy, mapping each hypothesis to the outcomes and comparisons used in the analysis. It clarifies how descriptive evidence, pre/post contrasts and deep-dive triangulation are combined to evaluate EU-facing greening, diversion towards non-EU markets and potential long-term upgrading.

3.1 Case selection and comparative logic

This thesis examines the extent to which EU preferential trade agreements (PTAs) are associated with changes in the environmental composition of exports from partner countries. The central empirical challenge lies in distinguishing between (i) EU-facing 'greening' (i.e. cleaner export baskets to the EU) and (ii) diversion/leakage (i.e. dirty exports being redirected from the EU to other destinations rather than being reduced overall). The research design therefore combines a destination-based, within-case comparison (EU versus Rest of World) with a cross-case comparison leveraging structured variation in agreement types, baseline export structures and time horizons. This two-level comparative approach is theory-driven and aligned with the hypotheses set out in the theory section.

---

[3] see Lieberman (2005) on nested analysis.

3.1.1 Case selection: Principles and criteria

The thesis employs a small-N, theory-guided case selection strategy. The aim is to achieve analytical leverage by selecting cases that demonstrate variation in the explanatory dimensions emphasised in the theory section. Particularly, the depth and sustainability of governance agreements, the extent of exposure to emissions-intensive ('dirty') sectors, and the time elapsed since implementation, while maintaining consistency in the analytical framework across cases. Although the four agreements differ in design and context, they are comparable for the purposes of this thesis because the analysis does not estimate a single, homogeneous 'treatment effect'. Instead, each case is evaluated using the same within-case benchmark — exports to the EU versus exports to non-EU destinations before and after the effective start year of the agreement — so the outcome concept remains consistent across cases. Therefore, variation in agreement depth, implementation credibility, export structure and shocks is not a threat to the design, but rather part of the analytical leverage. It enables the thesis to assess whether EU-facing adjustment appears consistently, and to interpret heterogeneity as evidence regarding mechanisms and scope conditions rather than as noise around a single causal parameter.

The selection of Vietnam, Ukraine, Ghana and Costa Rica was guided by five criteria:

First, credible EU policy 'treatment' within the observation window (2010-2024). All four cases have a clear point at which an EU trade regime becomes operational, whether through entry into force or provisional application. This enables a consistent before/after structure with sufficient pre-trends and post-coverage.

Second, there is variation in agreement type and governance depth (institutional design). The cases represent a spectrum of EU trade arrangements, from 'new generation' free trade agreements (FTAs) and deep and comprehensive free trade agreements (DCFTAs) with extensive rule coverage and sustainability governance, to more limited economic partnership agreements (EPAs). This provides structured variation for assessing whether deeper agreements are associated with stronger EU-facing compositional change.

Third, there is also variation in baseline export structure and CBAM exposure. The thesis's 'dirty' basket is motivated by CBAM-covered sectors (cement, aluminium, fertilisers, iron and steel, hydrogen and electricity). The selected cases differ markedly in their initial reliance on these upstream, emissions-intensive categories (e.g. Ukraine's steel-heavy baseline versus Costa Rica's comparatively low exposure), which affects both the potential for compositional change and the likelihood of diversion.

Fourth, time-horizon leverage: short-run sorting versus long-run upgrading. The set includes relatively recent agreements (with Vietnam and Ukraine) and a longer-standing arrangement (with Costa Rica), enabling the thesis to investigate whether the initial effects are dominated by destination-specific sorting and diversion, and whether deeper structural upgrading only occurs after several years.

Fifth, the four cases were deliberately selected from different regions and development contexts (Southeast Asia, Eastern Europe, West Africa and Central America). This cross-regional contrast enhances the analytical value of the case study design in two ways. Firstly, it reduces the risk of observed EU-facing compositional changes merely reflecting region-specific shocks or idiosyncratic sectoral cycles. Secondly, it allows for a more meaningful interpretation of heterogeneity: if EU-RoW export composition gaps evolve similarly across structurally diverse economies, this lends weight to the idea of a general EU-facing adjustment mechanism. Conversely, if patterns diverge, these discrepancies can be attributed to baseline endowments, sector specialisation, and institutional capacity. In this sense, the case set is intentionally 'most different' in terms of background characteristics, yet unified by a common analytical framework and comparable EU trade policy treatment.

3.1.2 The four cases: Rationale

Vietnam (VNM) is a comprehensive ‘new generation‘ free trade agreement (FTA) with explicit sustainability governance. Vietnam is selected as a case in which EU market access is embedded within a modern FTA framework, and where the impact of EU-facing adjustments, if they occur, should be most visible. The EU-Vietnam FTA came into force on 1 August 2020. The agreement contains a dedicated trade and sustainable development architecture, such as institutionalised forums and chapters on labour and the environment (European Commission, 2018). The EU-Vietnam Agreement is one of the top contenders in terms of environmental provisions[4], with 122 such provisions throughout the agreement. These range from plain environmental protection provisions (31), to implementation (19), enforcement (9), and development (8) (Morin, Dür and Lechner, 2018). This makes it an ideal case for testing whether deeper commitments correlate with EU-facing export ‘greening’.

Vietnam is a manufacturing economy with a high export intensity that is integrated into global value chains. Its leading exports are strongly concentrated in the electronics and telecoms sectors, as well as related manufacturing categories (WITS, 2023).

Ukraine (UKR) a high baseline level of dirtiness under a DCFTA with a strong regulatory approximation logic. Ukraine’s relationship with the EU differs structurally from that of a standard FTA partner. The European Commission explicitly states, that the Association Agreement (including the DCFTA) is the 'main tool' for bringing Ukraine closer to the EU (European Commission, 2023). It is also very ambitious in terms of its regulatory scope, as it involves reforms and approximation towards the EU acquis across numerous areas. The DCFTA has been provisionally applied since 1 January 2016, with the Association Agreement having been fully in force since 1 September 2017. From an economic perspective, Ukraine is highly relevant for 'dirty' composition questions because its exports include agriculture and basic metals. EU import data highlights cereals, vegetable fats and oils, oilseeds, iron, steel

[4] Environmental provisions are clauses in trade agreements that regulate or promote environmental protection (standards, cooperation, monitoring, and enforcement), as coded in the TREND database.

and ores as major categories destined for the EU (European Commission, 2024). The full text of the agreement contains 116 environmental provisions (Morin, Dür and Lechner, 2018). This aligns closely with theoretical expectations about regulatory spillovers and destination-specific adjustment. At the same time, Ukraine is also a challenging case because major shocks can affect both trade volumes and partner composition (Rogoff, 2022). The relevance of Ukraine's data in the context of Russia's invasion in February 2022 and the accompanying shock to its economy, will be discussed further at a later point in this thesis (Chapter 5.3.4).

Ghana (GHA) a 'stepping stone' EPA[5] with a shallower benchmark. Ghana has been selected as a case study in which the EU trade relationship is governed by a more limited EPA framework compared to DCFTAs and new-generation FTAs. The EU-Ghana 'stepping stone' EPA has been provisionally applied since 15 December 2016 (European Commission, 2025b). This type of agreement is generally considered to have a comparatively narrower regulatory scope. In practice, it focuses primarily on the trade regime for goods, since the EU-Ghana stepping-stone EPA is designed to preserve duty-free, quota-free access for Ghanaian exports to the EU and to create a predictable framework for trade and investment (EEAS, 2021). For this agreement, the TREND dataset lists 36 provisions, which is the least of the mentioned cases (Morin, Dür and Lechner, 2018). Ghana provides a contrasting African commodity-export case. Its export earnings are concentrated in gold, petroleum oils and cocoa, which differ structurally from Vietnam's manufacturing exports and Ukraine's agricultural and metal exports (Ghana Statistical Service , 2024). Analytically, Ghana helps to determine whether any observed 'greening' of the EU is specific to deeper institutional designs, or whether similar patterns also emerge under lighter arrangements.

Costa Rica (CRI) has a long-term outlook and a mixed high-tech/agricultural export profile. Costa Rica has been included primarily to address the time horizon problem, as it offers a substantially longer post-agreement period than newer agreements. The trade pillar of the EU-Central America Association Agreement has been in place since 2013, providing a longer period in which longer-term structural change could emerge (European Commission, 2013). In economic terms, Costa Rica is a 'mixed' exporter. Medical instruments and devices have become the country's leading export, although bananas and pineapples still account for a significant proportion of agricultural exports (OEC, 2023). This combination is analytically useful as it enables the thesis to examine compositional dynamics in an environment where 'green' upgrading pathways (through technology- and standards-intensive exports) are more feasible than in a purely commodity-based economy. Due to the length of its agreement, Costa Rica is the ideal case to observe whether EU-facing adjustments (if any) lead to broader compositional change over time. In other words, it is possible to determine whether

[5] A Stepping Stone Economic Partnership Agreement (EPA) is an interim trade deal between the EU and specific African, Caribbean or Pacific (ACP) countries. It ensures continued preferential market access, typically in the form of duty-free and quota-free trade, while providing a foundation for negotiating more comprehensive, long-term trade agreements.

initial EU-RoW gaps persist (consistent with sorting/diversion) or narrow as production and export capabilities evolve.

3.1.3 Comparative Logic: How these cases jointly identify patterns of interest

The thesis employs nested comparative logic to link evidence directly to hypotheses. A within-case EU/RoW comparison identifies destination-specific adjustments, while cross-case variation helps to evaluate the reasons for differences in patterns.
Within-case logic: EU vs. Rest of World as a built-in benchmark.
For each country, the analysis compares export composition to the EU versus non-EU (Rest of World) destinations around the time of agreement implementation. This is the core identification idea in descriptive form, by benchmarking patterns facing the EU against patterns facing the RoW for the same exporter and year, the design provides a transparent way to distinguish between:
EU-specific adjustment (consistent with EU market power, regulatory spillovers and compliance incentives) from broader global trends (e.g. commodity cycles, worldwide demand shifts and global decarbonisation dynamics), which should affect both destinations similarly. The comparison is empirically operationalised through destination-specific shares (dirty and green) and their EU-RoW gaps, which become central outcome variables in later sections. One practical implication of this logic is the use of mirror data for EU-bound trade. When exporter-reported bilateral exports to the EU are incomplete or inconsistent, EU-bound flows can be measured via EU-reported imports from the partner. This ensures comparability across cases and years, with consistent valuation in current USD as reported by Comtrade. This is especially important for constructing reliable EU versus RoW totals and shares in subsequent sections.

Cross-case logic: structured variation to probe mechanisms and scope conditions.
Having established the patterns within each case, the thesis compares the magnitude and direction of changes across the four cases. The 'most-different systems' logic is valuable here because, as the cases differ in terms of region, development profile, export structure and agreement design, any recurring pattern of EU-specific cleaning/greening across them would strengthen confidence in a general EU-facing mechanism. Conversely, systematic differences across cases can be interpreted as evidence for the theory's scope conditions, especially agreement depth/institutionalisation: Deeper agreements (e.g. the Vietnam EVFTA and the Ukraine DCFTA) should be more conducive to stable EU-facing adjustment than lighter stepping-stone EPAs (e.g. the Ghana EPA). Baseline dirty intensity: high exposure to CBAM-relevant sectors may create greater adjustment incentives and more opportunity for diversion to alternative markets. Time horizon: longer post-implementation periods (e.g. Costa Rica) are required to determine whether compositional change becomes economy-wide rather than destination-specific.

In combination, the four cases provide structured, theory-relevant variation, while the EU versus RoW comparison supplies a consistent benchmark for interpreting changes. This enables me to identify whether export baskets become cleaner/greener in EU-bound trade; assess whether such changes are mirrored outside the EU or offset by diversion; and relate cross-case differences to agreement design, baseline structure and time horizon, thus directly mapping the empirical strategy to the hypotheses in the next subsection.

3.2 Data sources and variable construction

This thesis combines detailed, customs-based trade data at product level with information on the design and environmental content of relevant EU trade agreements. The resulting dataset is a country-year panel (2010-2024) for Ukraine, Ghana, Vietnam and Costa Rica. It is designed to compare the composition of exports to the EU with that to non-EU destinations (RoW), and to track changes to this split around the time that each agreement comes into force (or is provisionally applied).

The core empirical material comprises annual merchandise trade data from UN Comtrade, a database established by the United Nations which aggregates detailed global annual and monthly trade statistics by product and trading partner and covers approximately 200 countries, representing more than 99% of global merchandise trade. The database was accessed via the UN Comtrade API using the comtradr R package. The empirical window is 2010–2024 (latest available), providing a substantial pre- and post-period for the agreements under study.

All trade values are taken from the value field in Comtrade and are expressed in current US dollars (nominal). UN Comtrade reports values in current USD, calculated using average annual exchange rates (derived from monthly rates, weighted by monthly trade volumes).

One practical implication is that the 'levels' series (USD values) reflects real changes in trade and movements in prices and exchange rates. Therefore, the analysis also emphasises composition measures (shares), which are less sensitive to inflation and exchange rates (UN Statistics Division, 2025).

Concerning the Geographic structure (EU vs. the rest of the world), the analysis requires a clean comparison between EU-bound trade (partner country to the EU) and non-EU-bound trade (partner country to the rest of the world). One complication is that the ‘exports to the EU’ in Comtrade can be inconsistent because the level of coverage varies depending on the reporter, and the EU is not always reported as a single aggregate partner rather than 27 individual destinations. Therefore, to ensure a consistent measure of EU-bound trade across countries and years, the thesis relies on mirror flows which are EU-reported imports from each partner country.

3.2.1 Product classification: 'dirty' and 'green' baskets

In order to operationalise the key distinction of the thesis — greening versus diversion — products are grouped into two pre-defined, HS-based baskets[6].

I use HS6 product codes because they strike the best balance between detail, comparability and feasibility for analysing the trade composition of the EU versus the Rest of the World over multiple years. More aggregated alternatives (HS2/HS4 or broad sector classifications) can obscure policy-relevant variation in the product mix, particularly when adjustments occur within a broad chapter rather than through a visible shift across chapters. This is particularly relevant for CBAM-proxied steel products. In the Vietnam deep dive, for example, the post-period increase in the 'dirty' composition facing the EU is driven by a sharp reorientation of specific steel HS6 lines within HS72 ('iron and steel'). These lines include flat-rolled steel products (HS 720838 and HS 720839) and coated flat products (HS 721049), whose EU shares rise markedly between the pre- and post-period. At the HS2 level, these dynamics would appear as a simple 'HS72', making it difficult to detect which product lines are driving the change, and to distinguish EU-facing sorting within particular steel categories from broader growth in steel exports. Using HS6 therefore reduces the risk of economically meaningful within-chapter restructuring being averaged out by aggregation, and improves the interpretability of EU–RoW gaps and diversion-oriented diagnostics.

Meanwhile, more 'direct' environmental metrics, such as embodied CO_2 estimates from input-output models or sector emissions intensities, require additional conversions and modelling assumptions that are not consistently available or transparent across countries and over the period from 2010 to 2024. Therefore, HS6 is the most appropriate level at which to capture meaningful compositional shifts in internationally comparable trade data, while ensuring that the measures are replicable and closely aligned with the policy-defined product scope.

'Dirty' exports are represented by goods that fall within the initial scope of the EU's Carbon Border Adjustment Mechanism (CBAM), the EU's flagship instrument that links market access to the carbon intensity of selected upstream sectors. The CBAM Regulation defines covered goods using Combined Nomenclature (CN) codes in Annex I. The initial scope includes cement, iron and steel, aluminium, fertilisers, hydrogen and electricity (European Union, 2023). Therefore, using CBAM-covered goods aligns the thesis' measure of 'dirty' exports with the most policy-relevant definition of carbon-exposed products in EU trade policy, capturing sectors where EU climate-related trade pressure is strongest.

'Green' exports are proxied using the Asia-Pacific Economic Cooperation (APEC) List of Environmental Goods, a widely used reference list that was endorsed in 2012 and identifies 54 environmental goods at the HS level (e.g. selected renewable energy equipment, as well as pollution control and monitoring devices) (APEC, 2025; World Bank, 2014). This provides

[6] HS codes refer to the Harmonised System (HS), an internationally standardised system for classifying products used in trade statistics. This thesis uses six-digit HS codes, which provide consistent, detailed product-level definitions across countries.

a consistent way to track whether export composition shifts towards goods commonly associated with environmental technologies and related equipment.

Both classifications are externally defined and publicly documented, which avoids the selection of favourable product categories ex post facto and improves replicability. Substantively, the two baskets map directly onto the theory and hypotheses. CBAM-type sectors capture exposure to EU climate-related trade pressure ('dirty' exposure), while environmental goods capture the area in which greening or upgrading could occur if firms shift towards cleaner technologies ('green' opportunity). Therefore, using these two policy-anchored baskets makes the hypothesis mapping clearer than relying on unrelated proxies.

3.2.2 Agreement design data

In this thesis, 'agreement depth' is represented by TREND's aggregate count of environment-related provisions in each agreement. This captures the breadth of the environmental governance signal embedded in the treaty text, i.e. the extent to which environmental objectives, cooperation mechanisms, institutional arrangements and procedural commitments are incorporated across chapters. This count is used as an indicator of regulatory ambition and salience that can be compared across agreements. It does not directly measure enforceability or implementation in practice, which are assessed separately through the case narratives. The methodological approach is based on the work of Morin, Dür and Lechner (2018) on mapping the trade-environment nexus.

In addition, the full texts of the treaties (i.e. the legal agreements themselves) are used as primary documents to support the qualitative descriptions of each type of agreement (e.g. DCFTA/Association framework vs. 'new generation' FTA vs. EPA) and to provide context for the discussion of key provisions in the case narratives.

3.2.3 Constructed trade variables

All outcome variables are constructed at the country–year level for the period from 2010 to 2024. For each country and year, the dataset categorises trade as either EU-bound or non-EU (RoW), before combining these destination-specific measures into a small set of indicators. These indicators directly correspond to the research questions and hypotheses, and include levels, shares, gaps, and diversion metrics.

The starting point is a set of value (level) variables in US dollars (USD) from UN Comtrade. EU-bound trade is measured using mirror flows — EU-reported imports from the partner country — so that 'exports to the EU' are captured consistently across countries and years. This yields three level measures of EU-bound trade: the value of 'dirty' exports to the EU (aggregated across HS6 codes in the 'dirty' basket), the value of 'green' exports to the EU (aggregated across HS6 codes in the 'green' basket), and total EU-bound trade (Comtrade TOTAL). In parallel, the dataset also records exporter-reported world totals for each country and year: the value of 'dirty' exports to the world, the value of 'green' exports to the world, and the total value of exports to the world (TOTAL). UN Comtrade reports these trade values in current USD.

Non-EU (RoW) trade is then calculated as the remainder of global exports, minus EU-bound trade. In other words, RoW values represent exports to all destinations except the EU, meaning that the two categories are mutually exclusive and exhaustive. This decomposition is central to the thesis as it enables the analysis to determine whether compositional change is concentrated in EU-bound trade (consistent with EU-specific incentives or constraints), or if similar changes are evident elsewhere. However, because EU-bound values are measured using mirror imports (typically reported on a CIF[7] basis), while world totals are exporter-reported exports (typically FOB[8]), small negative RoW residuals can occur in rare cases due to valuation and reporting differences. These cases are flagged in the data pipeline and are dealt with conservatively (for example, they are set to zero or treated as missing when ratios or logarithms are computed), so that they do not distort the interpretation of shares, gaps or trends.

In order to capture export composition, the thesis calculates destination-specific shares for dirty and green baskets (1-4). Conceptually, these shares measure the importance of each basket within a country's trade with the EU and with the Rest of the World. These proportions are unit-free (reported as percentages in tables and figures) and are the primary outcome for evaluating 'cleaning' or 'greening', independent of changes in the overall scale of exports. For all of the following Formulas 'c' indexes countries, 't' indexes years, and EU, RoW, and W denote EU-bound, non-EU (rest of world), and world totals. Dirty and green products do not exhaust total exports. As a result, the shares $sDirty_{ct}^{d}$ and $sGreen_{ct}^{d}$ (for d∈{EU,RoW}) are not complements and do not sum to one. Each measure captures the relative importance of the corresponding product group within destination-specific exports.

$$sDirty_{ct}^{EU} = \frac{Dirty_{ct}^{EU}}{Total_{ct}^{EU}} \text{ (1)}; \qquad sGreen_{ct}^{EU} = \frac{Green_{ct}^{EU}}{Total_{ct}^{EU}} \text{ (2)};$$

$$sDirty_{ct}^{RoW} = \frac{Dirty_{ct}^{RoW}}{Total_{ct}^{RoW}} \text{ (3)}; \qquad sGreen_{ct}^{RoW} = \frac{Green_{ct}^{RoW}}{Total_{ct}^{RoW}} \text{ (4)}.$$

The main comparative outcomes are the EU–RoW composition gaps (5/6), which summarise the differences in destinations within the same exporter and year. The 'dirty' gap indicates whether the export basket bound for the EU is cleaner than that bound for the RoW (a negative 'dirty' gap implies a lower 'dirty' share for the EU than for the RoW), while the 'green' gap indicates whether the export basket bound for the EU is greener than that bound for the

[7] CIF (Cost, Insurance, and Freight): The value of the good at the importer's border. It includes everything in the FOB price plus the cost of international shipping and insurance.

[8] FOB (Free on Board): The value of the good at the exporter's border. It includes the production cost and the cost of transport to the port/frontier, but stops before the good leaves the country.

RoW (a positive 'green' gap implies a higher 'green' share for the EU). These gap measures operationalise the central idea of the proposal's EU-versus-world benchmark for identifying destination-specific adjustments. The EU-RoW composition gaps measure differences in export composition across destinations at a given point in time. Changes in these gaps reflect destination-specific patterns but may also be influenced by global product-level trends common to both markets.

$$GapDirty_{ct} = sDirty_{ct}^{EU} - sDirty_{ct}^{RoW} \quad (5);$$

$$GapGreen_{ct} = sGreen_{ct}^{EU} - sGreen_{ct}^{RoW} \quad (6).$$

To address reallocation more directly, the dataset also includes an indicator that captures the importance of the EU within a country's dirty exports, namely the proportion of dirty exports destined for the EU rather than non-EU countries (7-9). A decline in this indicator following the implementation of the agreement, especially when EU-bound dirty exports fall and those bound for the rest of the world rise or decline less, is consistent with a shift in the destination distribution of dirty exports away from the EU. In the case-study deep dives, I also calculate the ‘EU destination share’ for specific HS6 product lines (e.g., steel codes) using the same numerator–denominator logic as Equations (7-9), to show whether a given product line becomes more EU-oriented over time. The EU-share indicators capture the importance of the EU market within a country’s total exports of a given product group. Variations in these measures reflect relative reallocation across destinations and are therefore interpreted jointly with changes in total export levels.

$$EUshareDirty_{ct} = \frac{Dirty_{ct}^{EU}}{Dirty_{ct}^{W}} \quad (7)\ ; EUshareGreen_{ct} = \frac{Green_{ct}^{EU}}{Green_{ct}^{W}} \quad (8);$$

$$EUshareTotal_{ct} = \frac{Total_{ct}^{EU}}{Total_{ct}^{W}} \quad (9).$$

Finally, the thesis uses logarithmic transformations of key level variables (total, dirty and green values for the EU and RoW) for descriptive analysis of magnitude and growth patterns. These log measures help to reduce skewness and facilitate the comparison of changes in trade scale over time, while remaining interpretable as log nominal values, given that the underlying trade data are in current USD.

3.2.4 Pre/post indicators and delta construction

In order to implement the within-case before–after logic set out in the research design, the dataset has been organised into country-specific pre- and post-agreement periods. The key requirement is a consistent rule for translating legal implementation dates (entry into force or provisional application) into an 'effective' start year that aligns with the annual frequency of the trade data.

This structure enables consistent summary comparisons to be made for all the outcomes introduced in Section 3.2. In particular, the thesis computes pre- and post-period averages for destination-specific trade levels (dirty, green and total values to the EU and to the rest of the world, compositional measures (dirty and green shares by destination) and comparative indicators (EU–RoW gaps and diversion-oriented measures). The difference between the post- and pre-averages ('deltas') provides an interpretable summary of how export composition and scale change around agreement implementation (10). These deltas are used throughout the empirical analysis to evaluate whether EU-bound trade becomes cleaner or greener, whether changes facing the EU differ from patterns in non-EU markets and whether the observed dynamics are more consistent with destination-specific sorting/diversion in the short term or broader upgrading over longer periods. The pre-post estimator reports differences in period averages rather than growth rates. As such, it summarises average changes across time windows and is complemented by time-series evidence to assess dynamic patterns.

$$\Delta Y_c = \overline{Y}_c^{post} - \overline{Y}_c^{pre} = \left(\frac{1}{|T_c^{post}|} \sum_{t \in T_c^{post}} Y_{ct} \right) - \left(\frac{1}{|T_c^{pre}|} \sum_{t \in T_c^{pre}} Y_{ct} \right) \quad (10).$$

3.3 Empirical Strategy and Hypothesis Mapping

This thesis employs a two-stage comparative empirical approach to evaluate the extent to which EU preferential trade agreements (PTAs) are linked to the 'greening' of exports from partner countries, and/or the diversion/leakage of emissions-intensive ('dirty') exports away from the EU and towards the rest of the world. The core logic is destination-based: if adjustment is mainly driven by EU market access and regulatory expectations, changes should be more evident in trade bound for the EU than in trade bound for non-EU countries. Therefore, comparing export composition to the EU with export composition to the rest of the world provides a transparent benchmark with which to distinguish destination-specific adjustment from broader global trends.

The analysis empirically tracks HS6-level trade for four cases (Vietnam, Ukraine, Ghana and Costa Rica) between 2010 and 2024. It focuses on the levels (values in current USD) and composition (shares) of two baskets: CBAM-relevant 'dirty' goods and APEC 'green' environmental goods. This empirical strategy description builds on the data and variable construction described in 3.2.

3.3.1 Within-case analysis: EU versus RoW around implementation

The analysis of each of the four focal cases (Vietnam, Ukraine, Ghana and Costa Rica) begins with a description of the baseline export profile in the pre-agreement period. Particular attention is paid to whether the EU initially receives an export basket that differs systematically from the rest of the world. This provides essential context for later interpretation, given that countries enter EU agreements with different initial structures and varying degrees of exposure to 'dirty' and 'green' product groups.

The main evidence from within each case comes from comparing destination-specific outcomes in the periods before and after the agreement became operational. As the trade data is annual, the thesis identifies an effective start year that reflects the point at which implementation plausibly affects annual totals. If the agreement becomes effective early in the calendar year (first half of the year), that year is treated as the first post-year. Conversely, if implementation occurs late in the year (second half of the year), the following year is treated as the first post-year. Applying this rule yields the following effective start years: Ukraine (DCFTA): 2016; Vietnam (EVFTA): 2021 (effective from August 2020); Costa Rica (EU–Central America Association Agreement, trade pillar): 2014 (effective from October 2013); Ghana (interim EPA): 2017 (signed/implemented in December 2016). Outcomes are then compared separately for EU-bound and RoW-bound trade across the two periods.

To determine whether changes are specifically associated with EU-facing trade rather than broader global trends, the analysis highlights the differences between the trajectories of the EU and the rest of the world. Two summary perspectives are employed. Firstly, changes in the EU–RoW composition gaps indicate whether the EU-bound export basket becomes cleaner/greener than the non-EU basket for the same exporter. Secondly, a simple 'EU minus RoW change' contrast provides a descriptive summary that is easy to interpret, showing whether the magnitude of post-implementation change is larger for EU-bound exports than for RoW-bound exports. Throughout, the thesis uses both multi-year pre/post averages and time-series visualisations to avoid over-interpreting short-term volatility and clarify whether adjustments occur abruptly around the time of implementation or evolve gradually over time.

3.3.2 Cross-case comparison and mechanism interpretation

Having established within-case patterns, the thesis compares results across cases to evaluate whether the observed differences align with the scope conditions implied by the theoretical framework. The cross-case comparison focuses particularly on how outcomes vary according to:

(i) agreement type and governance depth;

(ii) baseline export structure and exposure to 'dirty' categories; and

(iii) the time horizon since implementation.

This is analytically important because the same EU agreement can generate different compositional responses depending on the initial industrial structure and the feasibility of upgrading. The mechanism can be understood by asking three questions. Firstly, are EU-bound exports becoming cleaner or greener relative to the rest of the world, in line with EU-specific constraints or incentives? Secondly, is there evidence of diversion or leakage, whereby the proportion of 'dirty' exports to the EU declines while the proportion of 'dirty' exports to non-EU destinations remains stable or increases, or whereby the EU takes a smaller proportion of 'dirty' exports over time? Thirdly, do the patterns primarily appear as short-term destination sorting, or do they evolve towards broader compositional change consistent with long-term upgrading?

To strengthen the interpretation of the data beyond the level of aggregate shares and gaps, the thesis complements the cross-case benchmarking with two in-depth case studies (Costa Rica and Vietnam). These deep dives triangulate country-year outcomes with HS6-level diagnostics, providing a decomposition of pre-post changes into product-level contributors and an 'EU share within HS6' indicator to help distinguish EU-facing sorting from the broader upgrading of the overall export structure. The quantitative diagnostics are paired with a concise policy timeline overlay to assess whether the observed shifts align with the sequencing of domestic policies and credible regulatory expectations. Ghana and Ukraine are retained as comparison cases, where commodity concentration, implementation constraints and external shocks limit the ability to trace mechanisms, but help to define the conditions under which EU green trade governance signals are hardest to detect.

3.3.3 Hypothesis mapping

This subsection links each hypothesis to the specific empirical quantities constructed in Section 3.2. The central outcomes are: destination-specific dirty and green export shares and values for EU- and RoW-bound trade; the corresponding EU–RoW composition gaps; and a diversion-oriented indicator that captures the EU's share of 'dirty' exports. Together, these measures enable the thesis to distinguish between EU-specific compositional adjustments and broader global trends, and to evaluate whether changes are the result of cleaning/upgrading, diversion, or a combination of both.

Hypothesis 1 (H1) concerns adjustment to the EU: once an EU agreement is operational, the proportion of dirty goods in EU-bound exports should decrease and/or the proportion of green goods should increase. This hypothesis is evaluated by comparing outcomes for EU-bound trade before and after the effective start year of the agreement, first focusing on compositional measures and then corroborating these with evidence on trade levels. Specifically, the thesis assesses whether the shares of dirty and green goods bound for the EU move in the predicted directions in the post-period relative to the pre-period and whether these shifts are accompanied by corresponding changes in the levels of dirty, green and total EU-bound trade. This dual focus is important because the composition can change through changes in either the numerator (dirty or green exports) or the denominator (total exports).

Therefore, the analysis interprets H1 as being most strongly supported when the EU-bound shares shift in the expected direction in a sustained way, and when the level trends are consistent with the compositional interpretation. This is empirically presented through country-specific time-series plots with an implementation marker and through pre/post summary comparisons.

Hypothesis 2 (H2) addresses destination-specific effects and the possibility of leakage: It suggests that post-implementation changes will be more significant for EU-bound trade than for RoW-bound trade. This implies that the EU–RoW composition gap will shift towards the EU. The thesis evaluates H2 by explicitly benchmarking changes to EU-bound trade against contemporaneous changes to RoW-bound trade for the same exporter. This is captured in practice by whether the EU–RoW 'dirty' gap becomes more negative and the 'green' gap more positive in the post-implementation period. This indicates that the EU-bound export basket is becoming cleaner or greener relative to what the same country sells elsewhere. Additionally, the thesis provides a structured EU minus RoW change contrast to summarise whether post-implementation changes are systematically larger in EU-bound trade than in RoW-bound trade. The leakage/diversion component is assessed by combining evidence of composition and level: a pattern in which EU-bound dirty outcomes decline while RoW-bound dirty outcomes remain stable or rise, together with a falling EU share of dirty exports, is consistent with a reallocation of dirty exports away from the EU rather than a reduction in dirty exports overall. This approach ensures that the interpretation remains tied to the core puzzle of the thesis: the EU export basket may become cleaner even if dirty exports persist by being diverted to other markets.

Hypothesis 3 (H3) introduces agreement design as a scope condition, stating that deeper agreements with more comprehensive rule coverage and more institutionalised sustainability governance should be associated with stronger EU-facing compositional change than shallower arrangements, provided that the baseline export structure remains unchanged. As agreement depth varies by design across the selected cases, the thesis evaluates H3 through a cross-case comparison of within-case results. Specifically, the thesis compares the magnitude and direction of post-implementation changes in EU-bound shares and levels, as well as the movement in EU–RoW gaps, across the four countries. These differences are then related to the institutional character of each agreement, as described in Section 3.1 and documented in the treaty texts and systematic agreement indicators introduced in Section 3.2. The idea is not that depth mechanically produces identical outcomes in different contexts, but rather that deeper agreements, all other things being equal, are more likely to generate sustained EU-facing adjustment because they incorporate market access within broader regulatory and sustainability governance structures. Evidence consistent with H3 therefore takes the form of a cross-case pattern: cases governed by deeper agreements exhibit more pronounced EU-specific shifts (i.e. larger changes in EU-bound composition and larger movements in EU–RoW gaps) than cases governed by comparatively narrower arrangements. However, it should be recognised that baseline export structure can condition both the scope for change and the sectors affected.

Hypothesis 4 (H4) concerns timing and dynamics. It is expected that EU–RoW gaps will adjust relatively quickly after implementation through sorting and diversion. However, broader changes in overall export composition, if they occur, should only become apparent over longer timeframes as investment and capabilities adjust. This hypothesis is evaluated by examining whether changes cluster around the implementation threshold or emerge gradually over several years, using time series and event-time visual inspection alongside pre/post comparisons. Additionally, the analysis compares the early and later post-implementation years, investigating whether the initial changes are concentrated in EU-bound trade (consistent with destination-specific sorting/diversion), or if similar compositional shifts later emerge in RoW-bound trade and the overall export structure (more indicative of long-term upgrading). The case set enables this distinction to be made because Costa Rica has the longest post-agreement period, while Vietnam and Ukraine provide insight into the early-phase dynamics of more recent agreements.

Overall, hypothesis mapping provides a transparent link between theoretical expectations and empirical evidence. It specifies which destination-specific outcomes and EU–RoW contrasts will be examined during the pre- and post-implementation periods for each hypothesis.

4. Descriptive Overview of Export Structures

Building on the research design and variable construction outlined in Chapter 3, this chapter provides a descriptive overview of export structures in the four case countries (Vietnam, Ukraine, Ghana and Costa Rica), before turning to pre- and post-implementation comparisons. The chapter has two main objectives: first, to document the importance of 'dirty' (CBAM-relevant) and 'green' (environmental goods) exports in each country; and second, to demonstrate the differences in export composition between EU and non-EU destinations (RoW) before assessing any changes related to the agreement.

4.1 Baseline Export Composition Before EU Agreements

This section provides a breakdown of the baseline (pre-agreement) export composition of the four case countries. These baseline values are computed as pre-agreement averages for each country and are presented as destination-specific shares of the 'dirty' basket (the CBAM-relevant proxy) and the 'green' basket (the environmental goods proxy). Figures 4.1a and 4.1b illustrate these baseline shares for each destination, while Table 4.1 summarises the corresponding pre-period averages and EU–RoW differences. The pre-agreement period varies slightly for each country, from the start of the data to the beginning of the FTA: CRI: 2010–2013; UKR: 2010–2015; GHA: 2010–2016; VNM: 2010–2019.

Dirty export shares (Eq. 1;3) vary considerably across cases even in the pre-period (Figure 4.1a). Ukraine stands out as a high-exposure case, with roughly 29.32% of exports bound for the EU and 31.91% of exports bound for the Rest of the World falling into the 'dirty' category pre agreement. This indicates that carbon-intensive products make up a large part of Ukraine's export structure, irrespective of destination. This aligns with the EU's trade profile of Ukraine, in which iron, steel, and other resource-based categories are among the main export items by value (European Commission, 2024). In contrast, Ghana and Vietnam have low baseline dirty export shares to both destinations. Ghana's dirty share is approximately 1.36% for exports to the EU and 1.39% for exports to the Rest of the World (RoW), suggesting that CBAM-type categories are relatively insignificant in its baseline export basket. This is consistent with the EU's description of Ghanaian exports, which are dominated by food products (notably cocoa) rather than heavy industrial goods (European Commission, 2025a). Similarly, Vietnam starts from a low dirty baseline (1.62% to the EU and 3.64% to RoW), which aligns with the EU's import profile from Vietnam, which is concentrated in sectors such as machinery, electrical goods, footwear and textiles which are largely outside the CBAM proxy basket used here (European Commission, 2025d).

Costa Rica is the clearest example of a destination-specific baseline difference: the proportion of dirty exports bound for the EU is close to zero (0.02%), whereas the proportion

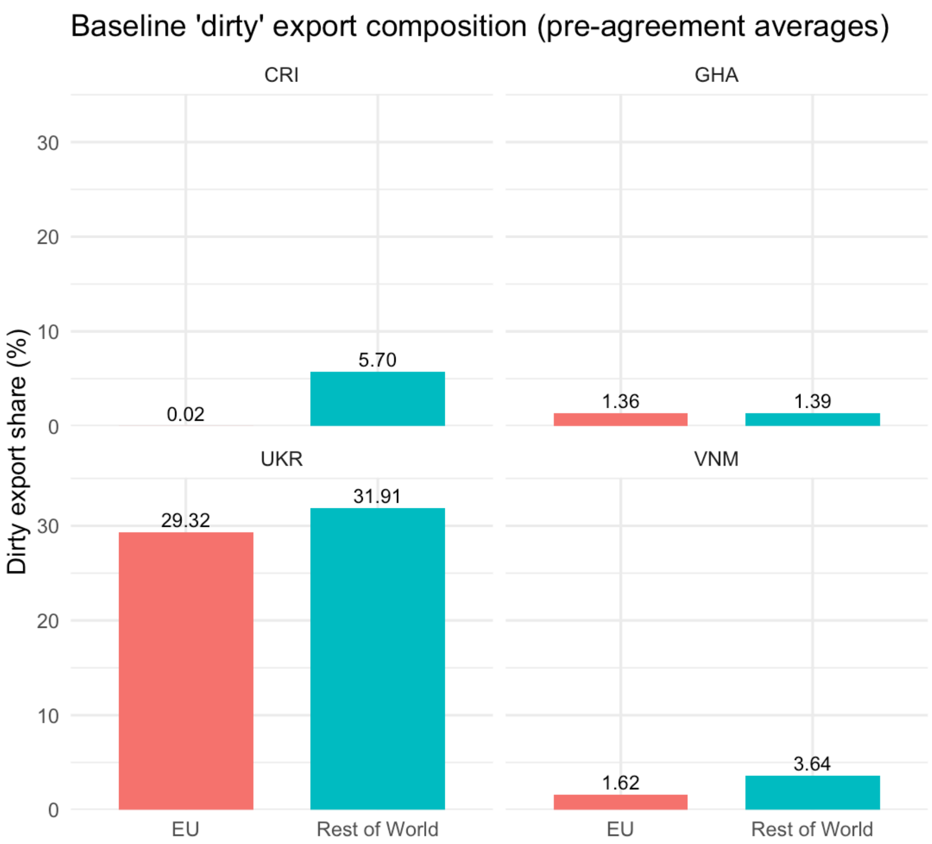

Fig. 4.1a Baseline 'dirty' export composition (Source: UN Comtrade)

of dirty exports bound for other regions is non-trivial (5.70%). This implies that the EU-facing basket is substantially 'cleaner' than the non-EU basket, even before considering the agreement window. A potential explanation is the product mix: EU imports from Central America/Costa Rica are dominated by foodstuffs (e.g. fruit such as bananas and pineapples) and medical instruments, which are not central to CBAM-relevant categories (European Commission, 2023).

Turning to the green basket, baseline green shares are small in all countries and systematically higher for exports to RoW than for exports to the EU (Figure 4.1b). Costa Rica’s EU green share is approximately 0.04%, compared to 0.41% for RoW. Ghana's figures are 0.16% (EU) and 0.24% (RoW), Vietnam's are 0.19% (EU) and 1.09% (RoW), and Ukraine's are 0.32% (EU) and 1.68% (RoW). Two descriptive implications follow. Firstly, green' export specialisation (as captured by the environmental goods proxy) is limited in EU-bound exports for all four cases at baseline. Secondly, the baseline pattern is that green exports are more concentrated in RoW than in the EU. Therefore, an increase in the share of green exports bound for the EU after the agreement would indicate a change in this baseline relationship rather than an amplification of an existing EU lead.

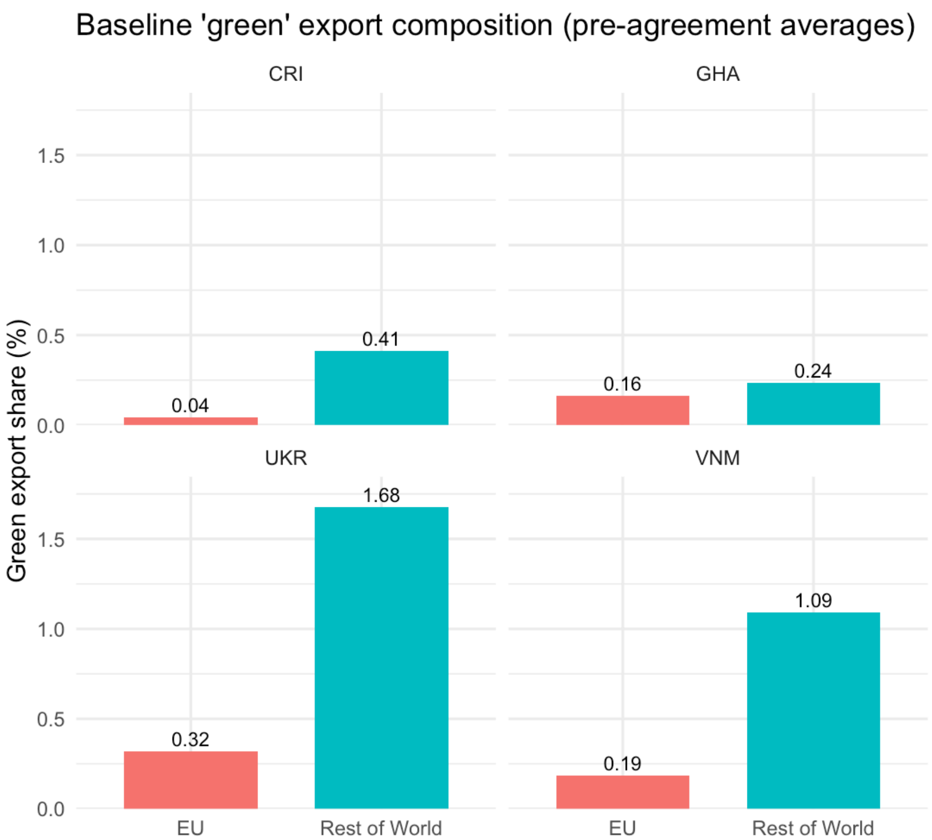

Fig. 4.1b Baseline ‘green’ export composition (Source: UN Comtrade)

Table 4.1 summarises the composition of exports to the EU versus the rest of the world at baseline (full pre-agreement period) and highlights the composition gaps between the EU and RoW, which are defined as the difference in destination-specific shares (Gap = EU share − RoW share, in percentage points). Therefore, a negative dirty gap means that the export basket bound for the EU is cleaner than the RoW basket at baseline (i.e. a lower dirty share bound for the EU), while a negative green gap means that the export basket bound for the EU is less green than the RoW basket (i.e. a lower green share bound for the EU). In all four cases, the dirty gap is negative, indicating that the EU tends to import a relatively cleaner basket even before the agreements. The gap is especially large for Costa Rica (EU dirty share: 0.02%; RoW dirty share: 5.70%; gap: −5.68 percentage points), while Ukraine also shows a meaningful negative gap despite high dirty exposure overall (EU dirty share: 29.32%; RoW dirty share: 31.91%; gap: −2.59 percentage points). Vietnam exhibits a smaller, yet still clear, baseline difference (1.62% versus 3.64%; gap: −2.02 percentage points), whereas Ghana shows almost no baseline destination difference (1.36% versus 1.39%; gap: −0.03 percentage points). Likewise, for the green basket, the gaps are negative in every case (ranging from −0.07 percentage points (pp) in Ghana to −1.36 pp in Ukraine), implying that shares of environmental goods are systematically higher in RoW exports than in EU-bound exports in the pre-period. Taken together, these baseline gaps demonstrate that destination-specific compositional differences are present prior to treatment, which is important for subsequent interpretation: post-agreement changes should be evaluated in terms of both levels and relative to these pre-existing EU–RoW differences.

Table 4.1 Baseline pre-display (Source: UN Comtrade)

Country	EU dirty (%)	RoW dirty (%)	Gap dirty (pp)	EU green (%)	RoW green (%)	Gap green (pp)
CRI	0.02	5.7	-5.68	0.04	0.41	-0.37
GHA	1.36	1.39	-0.03	0.16	0.24	-0.07
UKR	29.32	31.91	-2.59	0.32	1.68	-1.36
VNM	1.62	3.64	-2.02	0.19	1.09	-0.91

Overall, the baseline evidence highlights significant differences in initial conditions. Ukraine starts out as a high-dirty exporter to both destinations, while Ghana and Vietnam begin with low dirty exposure. Costa Rica, meanwhile, exhibits a pronounced baseline EU–RoW split, with an unusually clean EU-facing basket. These differences are important for interpreting later chapters, as post-agreement changes will be evaluated relative to these pre-existing variations in export structure and destination-specific composition.

4.2 Dirty and Green Export Profiles Across Cases

While Section 4.1 documented the baseline composition of exports to each destination, i.e. the proportion of 'dirty' and 'green' products, this section creates cross-case 'profiles' by adding scale and exposure. The key distinction lies in the denominator: in Section 4.1, measures such as 'share_dirty_eu' capture the proportion of 'dirty' exports to the EU within the total export basket. In contrast, Section 4.2 focuses on the importance of the EU as a destination for the relevant baskets. This is represented by the EU share of dirty exports, which is calculated by dividing dirty exports to the EU by total dirty exports across all destinations.

Table 4.2 summarises the baseline profiles for each country. In terms of overall trade scale, the pre-period data show substantial heterogeneity. Vietnam and Ukraine are major exporters, particularly to the Rest of the World (RoW), whereas Costa Rica and Ghana have smaller export volumes. The EU share of total exports also varies considerably: Costa Rica is the most EU-oriented overall (49.6% of its total exports go to the EU in the pre-period), while Vietnam is the least (19.4%), with Ghana (28.0%) and Ukraine (30.2%) falling somewhere in between.

Table 4.2 Scale exposure pre-agreement in USD and % (Source: UN Comtrade).

country_iso	start_year	pre_years	n_pre	eu_total_pre_bn	row_total_pre_bn	eu_share_total_pre	eu_share_dirty_pre	eu_share_green_pre
CRI	2014	2010–2013	4	5.18	5.31	49.6	0.4	9.0
GHA	2017	2010–2016	7	3.55	9.55	28.0	35.4	35.7
UKR	2016	2010–2015	6	17.06	40.25	30.2	28.6	7.8
VNM	2020	2010–2019	10	31.36	131.43	19.4	9.6	4.0

Figure 4.2 provides a more detailed view of exposure within the 'dirty' basket. Here, the ranking differs from that in Section 4.1, which focused on composition. Costa Rica's share of dirty exports to the EU is essentially zero (0.4%), indicating that, although Costa Rica sells a substantial proportion of its total exports to the EU, its dirty-sector exports are predominantly oriented towards non-EU markets. This implies a low level of EU influence on Costa Rica's dirty basket: any adjustment to dirty products induced by the EU would affect only a very small proportion of the country's dirty exports.

At the other end of the scale, Ghana shows the highest EU exposure for dirty exports (35.4%), followed by Ukraine (28.6%). This means that roughly one-third of Ghana's and close to one-third of Ukraine's baseline dirty exports are shipped to the EU. In contrast, Vietnam's EU exposure is lower (9.6%), suggesting that the EU is a relatively minor destination for its dirty exports despite its large overall export scale. These patterns are important for later interpretation: a country can have a comparatively 'clean' EU-bound basket in Section 4.1 yet still face meaningful EU exposure in the dirty sector if EU trade volumes are high. Conversely, a country can have low exposure even when overall EU trade is substantial.

The same exposure logic applies to the green basket (see Table 4.2). While Ghana's green exports are relatively EU-oriented (35.7% of green exports were shipped to the EU in the pre-period), Costa Rica and Vietnam show more limited EU exposure for green goods (9.0% and 4.0%, respectively). Ukraine's share of green exports bound for the EU is also modest at 7.8%, which is consistent with the broader finding from Section 4.1 that green exports bound for the EU tend to be small and that the Rest of the World (RoW) accounts for a larger share of baseline green activity.

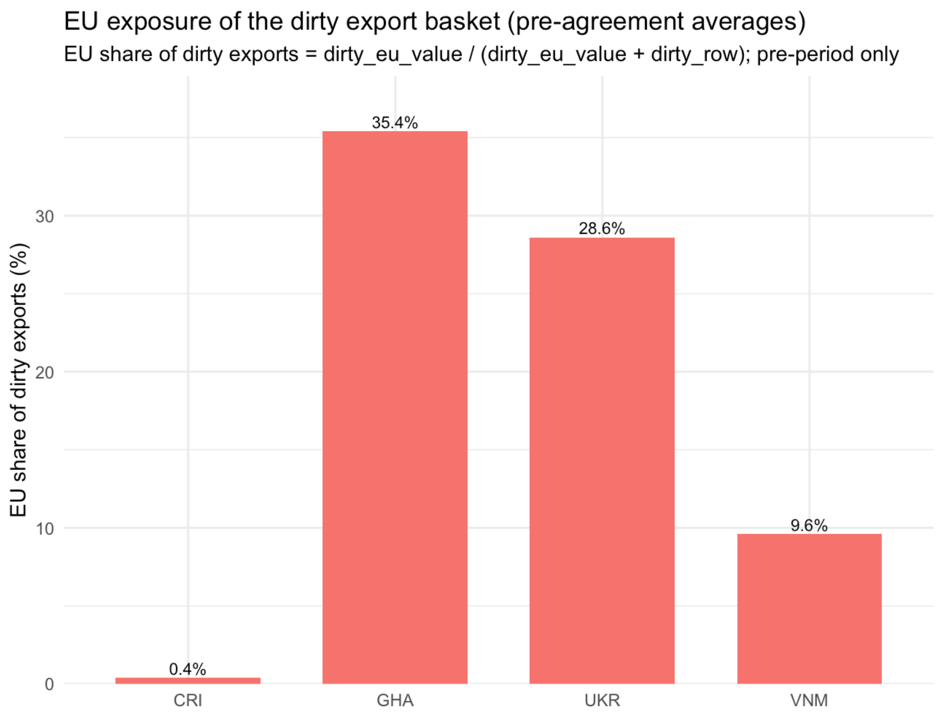

Fig. 4.2 EU exposure of the dirty export basket (Source: UN Comtrade)

4.2.1 What drives the dirty and green measures?

Before interpreting changes in 'dirty' (CBAM-relevant) and 'green' (APEC environmental goods) shares over time, it is useful to examine what these aggregates actually consist of at the HS6 level. The purpose of this basket check is twofold: First, to verify that the indicators are driven by product groups that are consistent with the intended classifications. Second, to assess concentration, i.e. whether the 'dirty' and 'green' measures are dominated by a small number of HS6 codes that could make the aggregate series volatile and sensitive to idiosyncratic, product-level shocks. What follows is a summary of the leading HS6 drivers of each basket by destination (EU vs. RoW) in the pre-agreement period (see the full table in the Appendix, Table A.1).

Regarding the dirty basket: Across cases, the dirty measure is primarily driven by the product families it is intended to represent — iron and steel, aluminium, fertilisers and cement — yet the degree of concentration varies significantly. Ghana's EU-bound 'dirty basket' is almost entirely aluminium: HS 760110 accounts for 58.8%, while HS 760120 accounts for 38.8%,

together making up around 97.6% of the EU 'dirty basket' in the pre-period. This implies that any movement in Ghana’s 'dirty to the EU' indicator will largely reflect shifts in aluminium shipments, rather than changes across multiple 'dirty' industries. Ukraine’s dirty basket is larger and more diversified, yet it is still structurally anchored in basic metals and upstream inputs. EU-bound dirty exports are led by steel and ores (e.g. HS 720712 at 28.4%, HS 260112 at 9.6% and HS 720851 at 7.3%), while RoW-bound dirty exports are likewise concentrated in several steel codes, as well as ores and fertilisers (e.g. HS 720720, 721420, 720711, and HS 260112). For later interpretation, it is important to note that changes in Ukraine’s dirty shares are likely to track the cycle of metals and ores, as well as large destination shifts in these heavy industries, rather than marginal adjustments in small product lines. Vietnam’s EU-bound ‘dirty’ basket is heavily driven by iron and steel articles, especially fasteners (HS codes 731815, 731812 and 731814 together contribute roughly 39% of the EU ‘dirty’ basket pre-agreement), whereas Vietnam’s RoW-bound ‘dirty’ basket includes major cement components (HS codes 252310, ‘cement clinkers’, and 252329, ‘Portland cement’, are among the top codes). This split in destinations is important because it implies that the 'dirty' adjustment could differ depending on whether the EU side is dominated by processed metal manufacturers or the RoW side includes more cement-related products. In value terms, Costa Rica’s EU-bound dirty basket is comparatively small, and its composition is dominated by aluminium and steel items (e.g. HS 760711 at 39.7% and HS 720260 at 27.2%). In contrast, the RoW dirty basket includes steel and fertiliser codes among the leading contributors (e.g. HS 721041, 721420 and 310590).
Regarding the green basket: The green measure is generally driven by machinery, electrical equipment and measuring and checking instruments (reflecting the APEC environmental goods list). It is often highly concentrated within a small number of codes. Vietnam is the clearest example. HS 901380 alone accounted for 44.8% of the EU green basket and 48.6% of the Rest of the World (RoW) green basket in the pre-period, with electrical machinery parts (e.g. HS 850490) also playing a significant role in the RoW green basket. Ukraine’s green basket shows destination asymmetry: EU-bound green exports are led by machinery-related codes (e.g. HS 841199 at 17.1%, HS 841290 at 12.9% and HS 847982 at 12.3%), while RoW-bound green exports are strongly influenced by HS 841182 (at around 28.3%), alongside other machinery and instrument codes. Similarly, Costa Rica’s green basket for the EU is concentrated in machinery parts (e.g. HS 841199 and 842199, which together account for nearly half of the EU green basket), while its green basket for RoW is led by measuring and checking instrument categories (e.g. HS 903289) and electrical machinery parts (e.g. HS 854390). Similarly, Ghana’s green basket consists of a small set of machinery and instrument codes for both destinations (e.g. HS 841182, 901580 and 841199 for the EU).

This is important for the rest of the analysis. The key implication is that, while the dirty/green indicators capture meaningful sectoral content, they do not represent 'broad' composition evenly. In several cases, especially Ghana (dirty) and Vietnam (green), a single product family (or even a single HS6 code) accounts for a large proportion of the total. This has two consequences for interpretation later on. Firstly, apparent 'greening' or 'cleaning' in shares may reflect reallocation at the product level within a narrow set of goods (e.g. aluminium or a specific machinery code) rather than upgrading across the entire economy. Secondly, concentrated baskets can generate sharp movements in response to shocks (e.g. price changes, supply disruptions or firm entry/exit) that are not necessarily PTA-driven. For this reason, subsequent before–after comparisons and EU–RoW gap analyses are interpreted in conjunction with destination-specific scale measures and this HS6 basket composition evidence to avoid over-attributing product-specific swings to the effects of the agreement.

4.3 EU vs World Export Patterns (Pre-Agreement)

This section provides context for the subsequent before-and-after analysis by documenting how the export composition of each country to the EU compares with its exports to the rest of the world prior to the relevant EU agreement taking effect. Unlike Sections 4.1 and 4.2, which provide static baseline snapshots of pre-agreement averages and place these in context by describing cross-country differences in scale and EU market exposure respectively, Section 4.3 introduces the time dimension. The aim is to establish whether there are any differences in the composition of EU–RoW exports at baseline and whether these differences display any clear pre-agreement trends that should be considered when interpreting post-agreement patterns. Figures 4.3a–c therefore plot destination-specific 'dirty' and 'green' export shares, as well as the corresponding EU–RoW composition gaps, over time. The effective start year of the agreement is marked for reference. This section's discussion focuses on the pre-agreement period (to the left of the dashed line). Post-agreement observations are included only for visual context and will be analysed in the results chapter.

Figure 4.3a shows the proportion of 'dirty' exports going to the EU and the rest of the world (RoW) separately. The dashed vertical line marks the effective start year of the respective EU agreement. Here, the focus is on the period before the agreement came into effect to assess whether the basket facing the EU already differed from that facing the rest of the world before any agreement-related adjustment could plausibly occur.

The figure reveals strong heterogeneity in levels and EU–RoW alignment across cases. Ukraine stands out as structurally 'dirtier' than the other cases. In the pre-period, dirty shares are high for both destinations (roughly in the 25–35% range), which is consistent with metals and other CBAM-proximate sectors playing a large role in its export mix. Notably, the EU and RoW series are similar and move together for much of the pre-period, indicating that Ukraine's exposure to dirty exports is not primarily an EU-specific phenomenon at baseline, but rather a broader feature of its export structure. By contrast, Costa Rica shows the opposite configuration: dirty shares to the EU are near zero throughout the pre-agreement period, while dirty shares to RoW are clearly higher (around the mid-single digits). This

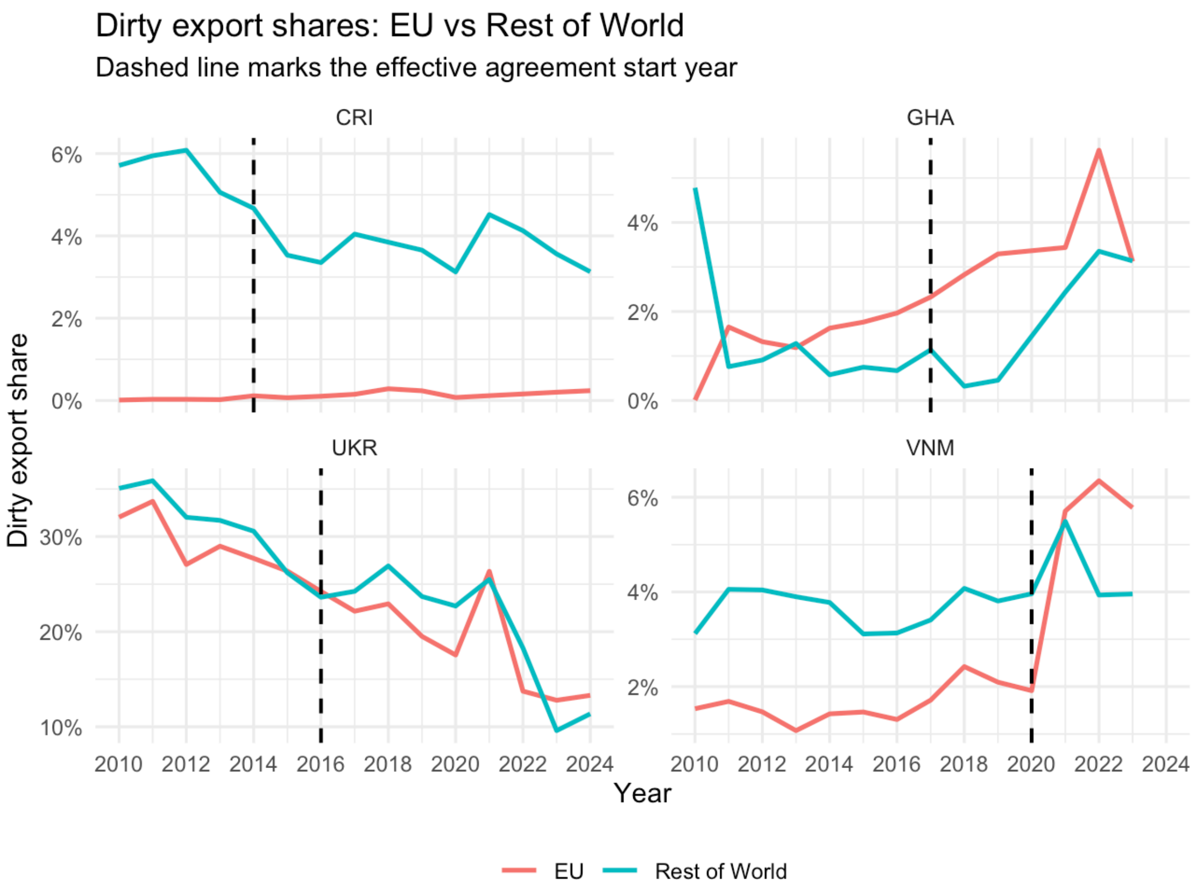

Fig. 4.3a Dirty export shares: EU vs RoW (Source: UN Comtrade)

implies that any 'EU cleanliness' for Costa Rica was already present before the agreement and was driven by destination-specific composition rather than by changes occurring at the time of entry into force.

While Vietnam and Ghana fall between these extremes, they still demonstrate clear pre-agreement differences between the EU and RoW. Vietnam's EU dirty share consistently remains below its RoW share during the pre-period, indicating that the EU-bound basket is cleaner than what Vietnam sells elsewhere, even before the agreement. Ghana shows a more mixed pattern in the early years: RoW dirty shares are initially higher, but the two lines converge and the EU share gradually rises over the pre-period. This highlights that EU–RoW differences are not only level differences, but can also involve pre-trends that matter for later interpretation. Overall, Figure 4.3a is an important pre-analysis check. In several cases, notably Costa Rica and Vietnam, the EU already receives a cleaner export basket than RoW prior to the entry of the agreement, whereas in Ukraine, the difference between the EU and RoW is comparatively small given the high overall level of 'dirty' exposure. This makes it necessary to use the subsequent gap figures and before–after comparisons to distinguish between baseline destination sorting and shifts in export composition after the agreement came into effect.

Figure 4.3b summarises the difference between the EU and RoW in 'dirty' export composition in a single, easy-to-read outcome: the 'dirty' composition gap. As the gap represents a difference in shares, it is measured in percentage points. The horizontal dashed line at zero is the key reference point: values below zero indicate that the export basket bound for the EU is cleaner than the export basket bound for non-EU countries (i.e. the share of 'dirty' exports to the EU is lower), whereas values above zero indicate that the export basket bound for the EU is dirtier than the export basket bound for non-EU countries. Combining the two destination lines into a single gap line is important for the rest of the thesis because it captures the core 'destination-based Brussels effect' logic directly: not whether a country is 'dirty' overall, but whether it ships a systematically different (cleaner or dirtier) composition to the EU than to other destinations.

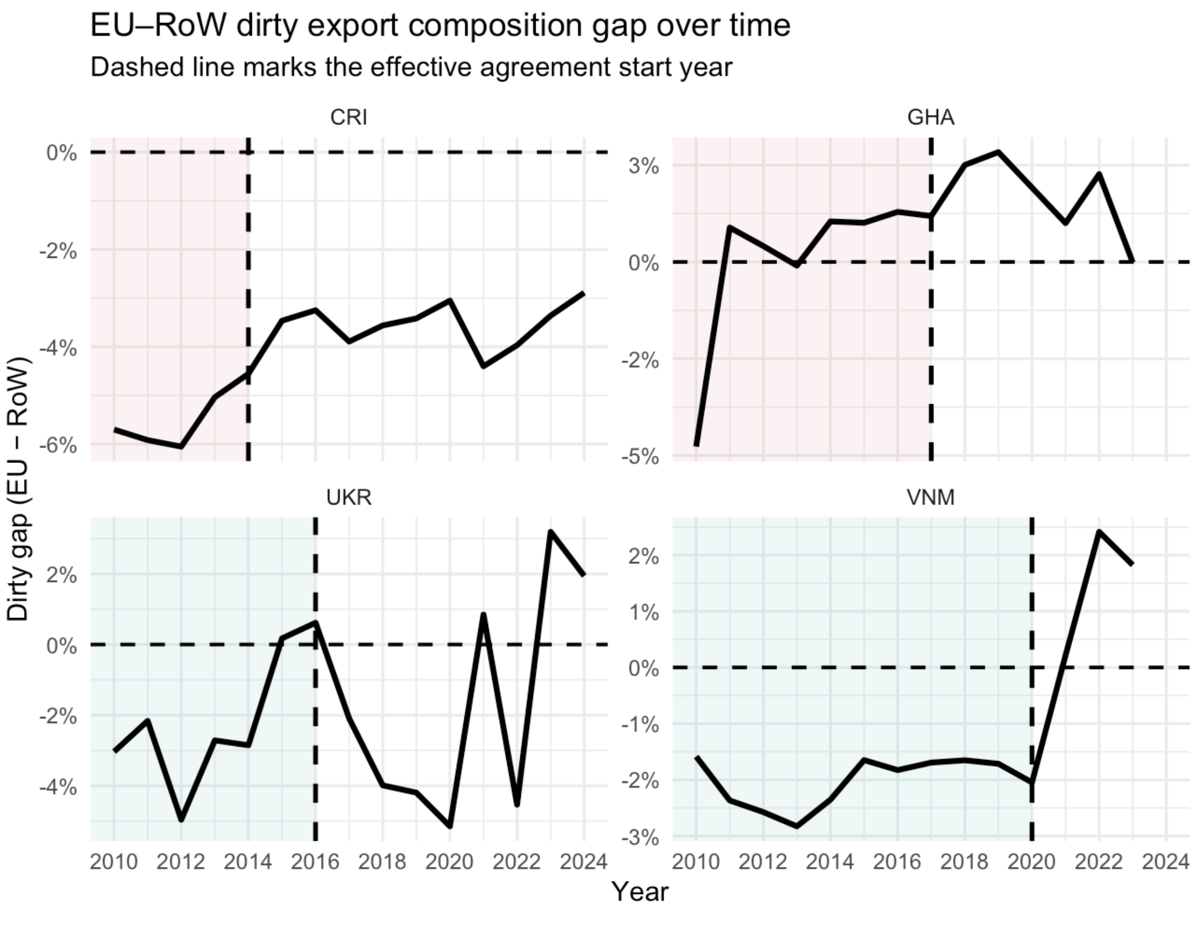

Figure 4.3b EU-RoW dirty export composition gap (Source: UN Comtrade)

Three baseline patterns stand out when looking across cases. Costa Rica (CRI) shows a consistently negative trend throughout the sample, with a significant difference already evident prior to the start of the agreement (approximately −6 to −4 percentage points). This suggests that even prior to the agreement, the EU received a significantly cleaner Costa Rican export basket than the rest of the world. While the gap narrows somewhat over time, it remains consistently below zero. Ghana (GHA), on the other hand, shows the opposite configuration after the initial years: while the gap is negative at first, it becomes positive from around 2011 onwards and remains mostly above zero (around 0 to +3 percentage points). In other words, relative to Ghana's non-EU exports, the EU-bound basket tends to be slightly more 'dirty' in composition in most years — an important reminder that EU specificity does not always point towards 'cleaner' shipments, and can reflect the particular products that Ghana sells to Europe. Before 2020, Vietnam (VNM) is largely negative (the EU is cleaner than the rest of the world), but the series crosses into positive territory after the agreement start year. This implies a shift towards a relatively dirtier EU-bound composition in the later period. Finally, Ukraine (UKR) is the most volatile. It starts negatively in the early 2010s, briefly approaches zero in the mid-2010s, then turns strongly negative again before moving into positive territory in recent years. This volatility is consistent with the fact that Ukraine's overall export structure is heavily influenced by large, cyclical 'dirty' sectors (e.g. metals), meaning changes in destination composition and relative prices can substantially alter the gap even without a clean, monotonic trend (European Commission, 2024).

For the purposes of this descriptive chapter on pre-agreements, Figure 4.3b is primarily diagnostic: it shows whether the EU already receives a cleaner basket on average before the agreement comes into force (as was the case with Costa Rica, and earlier with Vietnam), and whether pre-existing trends or instability are present (as was the case with Ukraine and Ghana). It is crucial to establish these baseline patterns before interpreting any post-agreement movements, because a persistent negative (or positive) gap before treatment suggests that part of the EU–RoW difference reflects pre-existing destination sorting rather than agreement-induced adjustment.

Figure 4.3c uses the same gap logic as Figure 4.3b, but for the green export composition. Thus, values above zero indicate a greener export basket to the EU than to the rest of the world, while values below zero imply the opposite. Since green shares are small in absolute terms, the y-axis is correspondingly tight; therefore, movements that appear 'small' can still represent significant relative changes in a narrow green basket.

Three descriptive patterns stand out. Firstly, Costa Rica (CRI) demonstrates a clear shift from negative to positive over time. The green share bound for the EU starts below the RoW benchmark in the early 2010s. However, after the mid-2010s, it rises and remains positive throughout the later period, peaking at around a few tenths of a percentage point. This suggests that, over time, Costa Rica's EU-facing export mix becomes relatively more 'green' than its non-EU mix, even if the overall green share remains small.

Secondly, Ghana (GHA) fluctuates around zero, with a pronounced negative dip at the beginning and then a period of slightly positive gaps around the time the agreement started, before drifting back towards zero (with a slight negative trend at the end). This suggests that there is no consistent differentiation between the EU and RoW in terms of green composition for most years. Rather, the size and direction of the gap appear to be sensitive to a small number of products and year-on-year changes, which is exactly what would be expected when the green basket is narrow.

Thirdly, the green gap remains consistently negative for Ukraine (UKR) and Vietnam (VNM) throughout most of the sample period. This means that the green share of their exports bound for the EU is smaller than that of their exports bound for the Rest of the World (RoW). For Ukraine, the green gap becomes less negative over time, approaching zero by the end of the period, which implies a gradual narrowing of the difference between the EU and RoW. In contrast, Vietnam's green gap remains consistently negative, with a notable increase after 2020. This suggests that any 'green' specialisation in Vietnam's exports is more oriented towards non-EU destinations in the later years.

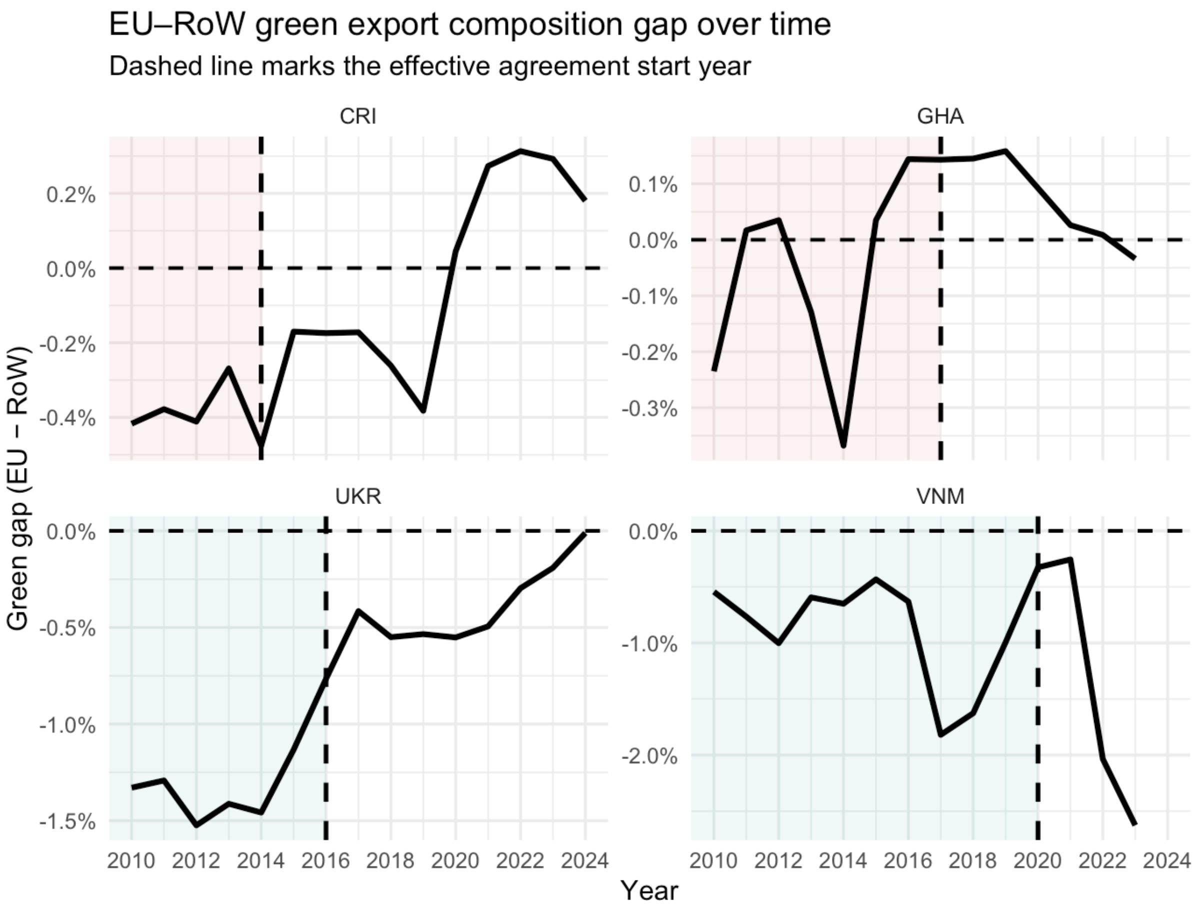

Fig. 4.3c EU-RoW green export composition gap (Source: UN Comtrade)

Overall, the pre-agreement time series patterns show that the composition of exports bound for the EU often differs from that bound for the Rest of the World (RoW) even before the start year of the agreement, and that these differences are not uniform across cases. In the 'dirty' dimension, some countries display a consistent separation between their EU and RoW baskets (e.g. Costa Rica's EU basket is consistently cleaner), while others show smaller or more unstable gaps (e.g. Ghana) and significant differences in levels driven by underlying sectoral structure (Ukraine).

For 'green' exports, the gaps are typically smaller in absolute terms and more sensitive to the size of the green basket. However, the sign and persistence of EU–RoW differences still vary systematically across countries. These pre-agreement patterns are important for interpretation as they imply that post-agreement changes should be considered deviations from country-specific baselines and trends rather than shifts from a common starting point.

5. Results: EU-Facing Adjustment and Destination Gaps

Chapter 5 presents the thesis's main empirical results. Based on the descriptive evidence presented in Chapter 4 and the measurement strategy introduced in Chapter 3, the analysis examines whether there are systematic differences in export composition between EU-bound trade and exports to the rest of the world, and whether these patterns evolve once the relevant EU trade agreement takes effect. The results are organised around four hypotheses. Section 5.1 tests the hypothesis that the composition of exports to the EU becomes less 'dirty' and/or more 'green' after the agreement comes into force (H1). Section 5.2 examines whether EU-specific adjustment is reflected in widening or narrowing EU–RoW composition gaps (H2). Section 5.3 then compares these patterns across cases with different levels of agreement (H3). Finally, Section 5.4 assesses the timing of the observed changes, determining whether they appear immediately (consistent with short-run sorting/diversion) or only after several years (more consistent with gradual upgrading and capability change) (H4). Throughout, the focus is on descriptive, within-case comparisons: the evidence is interpreted as patterns that are either consistent with or inconsistent with the hypotheses, rather than as causal estimates.

5.1 Changes in Export Composition to the EU

Table 5.1 summarises the change in the composition of EU-bound exports within each country before and after the effective start year of each agreement. For each case, the table reports the pre- and post-period averages of the EU dirty export share (Eq. 1) and the EU green export share (Eq. 2), both expressed as a percentage, as well as the percentage point change. Therefore, positive (negative) Δ values indicate that the relevant share increased (decreased) in the post-agreement period.

Taken together, the patterns provide limited support for Hypothesis 1, with the cleanest evidence being that of Ukraine[9]. Here, the proportion of dirty exports bound for the EU falls

[9] Ukraine's post-agreement trends coincide with significant wartime disruption (from 2022 onwards) and temporary policy measures that affect trade routes and market access. Therefore, interpretation here is necessarily cautious; the implications of these shocks are discussed explicitly in Chapter 6.

Table 5.1a EU pre- post-composition (Source: UN Comtrade)

country_iso	start_ year	pre_years	post_years	n_pre	n_post	EU dirty share (pre) %	EU dirty share (post) %	Δ EU dirty (pp)	EU green share (pre) %	EU green share (post) %	Δ EU green (pp)
CRI	2014	2010-2013	2014-2024	4	11	0.02	0.16	0.14	0.04	0.19	0.15
GHA	2017	2010-2016	2017-2023	7	6	1.36	3.44	2.08	0.16	0.1	-0.07
UKR	2016	2010-2015	2016-2024	6	9	29.32	19.17	-10.14	0.32	0.42	0.1
VNM	2020	2010-2019	2020-2023	10	4	1.62	4.94	3.32	0.19	0.44	0.26

by 10.1 percentage points (from 29.3% to 19.2%), while the proportion of green exports increases by a modest 0.1 percentage points (from 0.32% to 0.42%). This aligns with the directional prediction of the hypothesis (dirty down, green up) and is also substantively meaningful, given Ukraine's high baseline CBAM exposure, as documented in Chapter 4.

For Costa Rica, the post-period shift sees the dirty share rise in the opposite direction: the EU dirty share increases from 0.02% to 0.16% (+0.14 percentage points). At the same time, the EU's green share increases from 0.04% to 0.19% (+0.15 percentage points). Taken together, these figures suggest that Costa Rica's EU basket is becoming more 'green' in relative terms, but not cleaner according to the CBAM proxy measure. It is important to note that Costa Rica starts from an extremely low EU dirty share (see Chapter 4.1), meaning that even small absolute changes can generate significant percentage point movements. This is why time-series evidence (see Figures 5.1a–b) is required to determine whether the increase reflects a sustained shift or just a few years.

Ghana and Vietnam are the countries where the increase in the dirty component is most evident[10]: Ghana's EU 'dirty' share rises from 1.36% to 3.44% (an increase of 2.08 percentage points), and Vietnam's rises from 1.62% to 4.94% (an increase of 3.32 percentage points). However, Vietnam simultaneously shows a considerable rise in the EU green share (+0.26 percentage points, or pp, from 0.19% to 0.44%), whereas Ghana's EU green share falls (by 0.07 pp, from 0.16% to 0.10%). These patterns are inconsistent with the 'dirty decrease' part of Hypothesis 1 and, at least for Ghana, inconsistent with 'green increase' too. For Vietnam, the combined movements suggest a post-agreement reorganisation of EU-bound exports that includes more green products, as well as more CBAM-proxied products. This foreshadows the need to distinguish 'cleaning' from broader market access and sectoral expansion effects in subsequent sections.

Figure 5.1a shows the proportion of exports to the EU that are 'dirty'. The dashed vertical line marks the start year of the effective agreement, enabling changes in the series to be interpreted as descriptive pre/post patterns. Unlike Chapter 4's EU–RoW comparisons, this figure focuses purely on the composition of exports to the EU: it shows whether the basket of goods bound for the EU becomes more or less 'dirty' over time. An upward movement indicates that CBAM/dirty products make up a larger share of exports shipped to the EU ('dirtier' EU basket), while a downward movement indicates a reduction in the dirty share

[10] The post-period HS6 composition underlying these changes is summarised in Appendix Table A.2

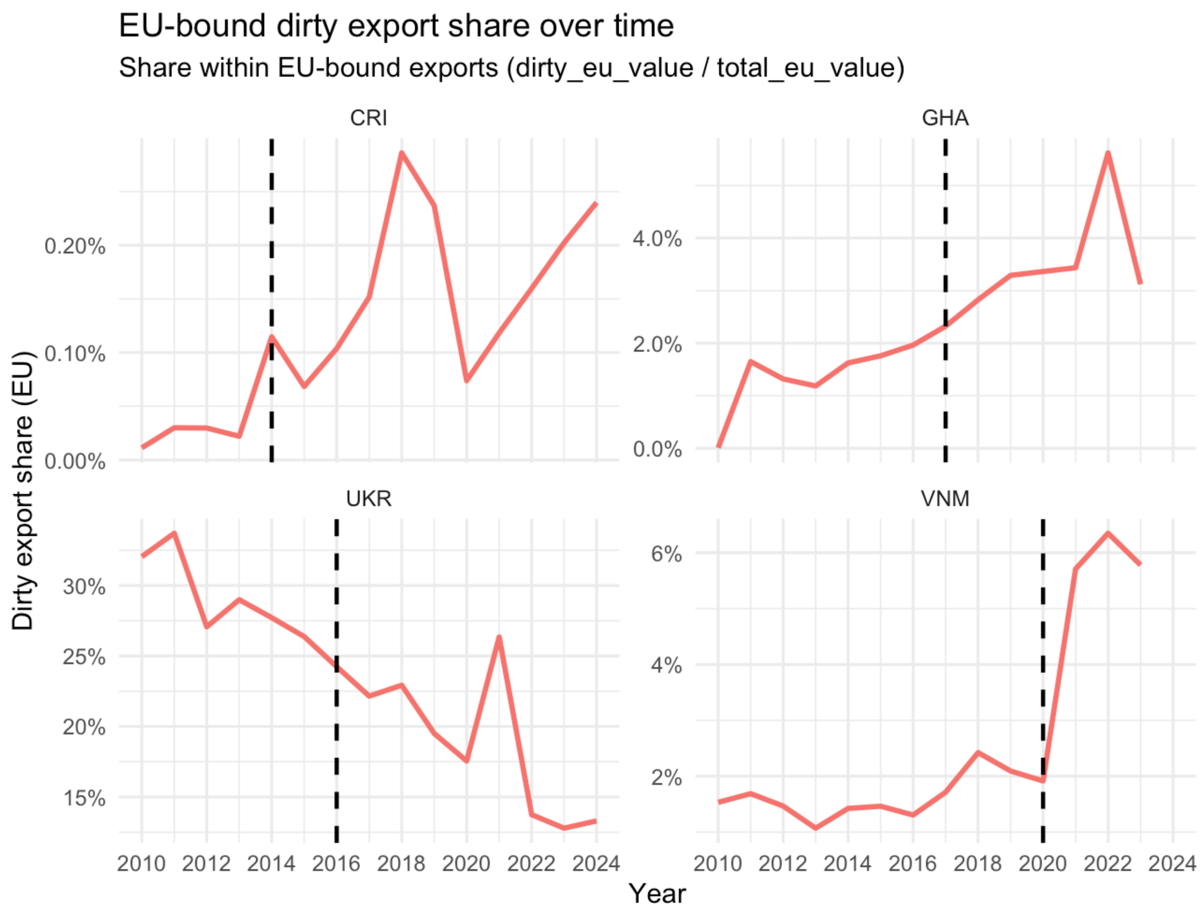

Fig. 5.1a EU-bound dirty export share over time (Source: UN Comtrade)

('cleaner' EU basket). As expected based on the baseline evidence in Chapter 4, pre-agreement patterns differ substantially across cases. Ukraine starts with a structurally high 'dirty' share (reflecting its strong exposure to metals and other carbon-intensive goods), whereas Costa Rica, Ghana and Vietnam display comparatively low 'dirty' shares prior to the start of the agreement. Post-agreement developments are heterogeneous. Ukraine (UKR) exhibits the most evident shift consistent with EU-oriented 'cleaning': the proportion of dirty exports destined for the EU declines steadily from the mid-2010s onwards, despite a temporary increase around 2021, and drops sharply after 2022. While this pattern aligns with the expectation of declining dirty exposure in the EU market under Hypothesis 1, caution is required when interpreting the results for Ukraine because the collapse after 2022 likely reflects war-related disruption and broader trade reorientation rather than the effects of the agreement alone (this is discussed explicitly when interpreting the results across the hypotheses).

For Vietnam (VNM), the proportion of dirty exports to the EU rises markedly after the start of the agreement, indicating that dirty products become more prominent in the EU export basket rather than shrinking in importance. Ghana (GHA) shows a similar upward trend after the agreement, with a pronounced peak in the early 2020s, suggesting that the relative importance of dirty exports in EU shipments is increasing over time. Costa Rica (CRI) remains low throughout, but also exhibits an increase from an initially near-zero baseline with episodic spikes in later years. Taken together, Figure 5.1a shows that a decline in the EU-bound dirty share is not a consistent post-agreement outcome; rather, adjustment to the 'dirty' margin appears to be strongly case-dependent. Returning to the summary pre/post table and the accompanying green-share results (Figure 5.1b) is therefore necessary in order to assess whether the EU-facing pattern is better characterised as (i) a shift away from dirty exports or (ii) an increase in green exports alongside persistent (or even growing) exposure to dirty exports.

Figure 5.1b shows the proportion of green exports within EU exports. As shown in Figure 5.1a, the dashed vertical line indicates the year in which the agreement took effect, enabling descriptive comparisons to be made between the trajectories before and after the agreement came into force. An upward movement indicates that 'green' products account for a larger proportion of exports shipped to the EU ('greener' EU-bound exports), whereas a downward movement indicates that 'green' products are becoming relatively less important within EU-bound exports.

Two broad patterns stand out. First, Vietnam (VNM) exhibits the most significant increase following the agreement: the green share rises sharply from the start of the agreement and reaches its highest levels in the early 2020s. This is consistent with the 'green expansion'

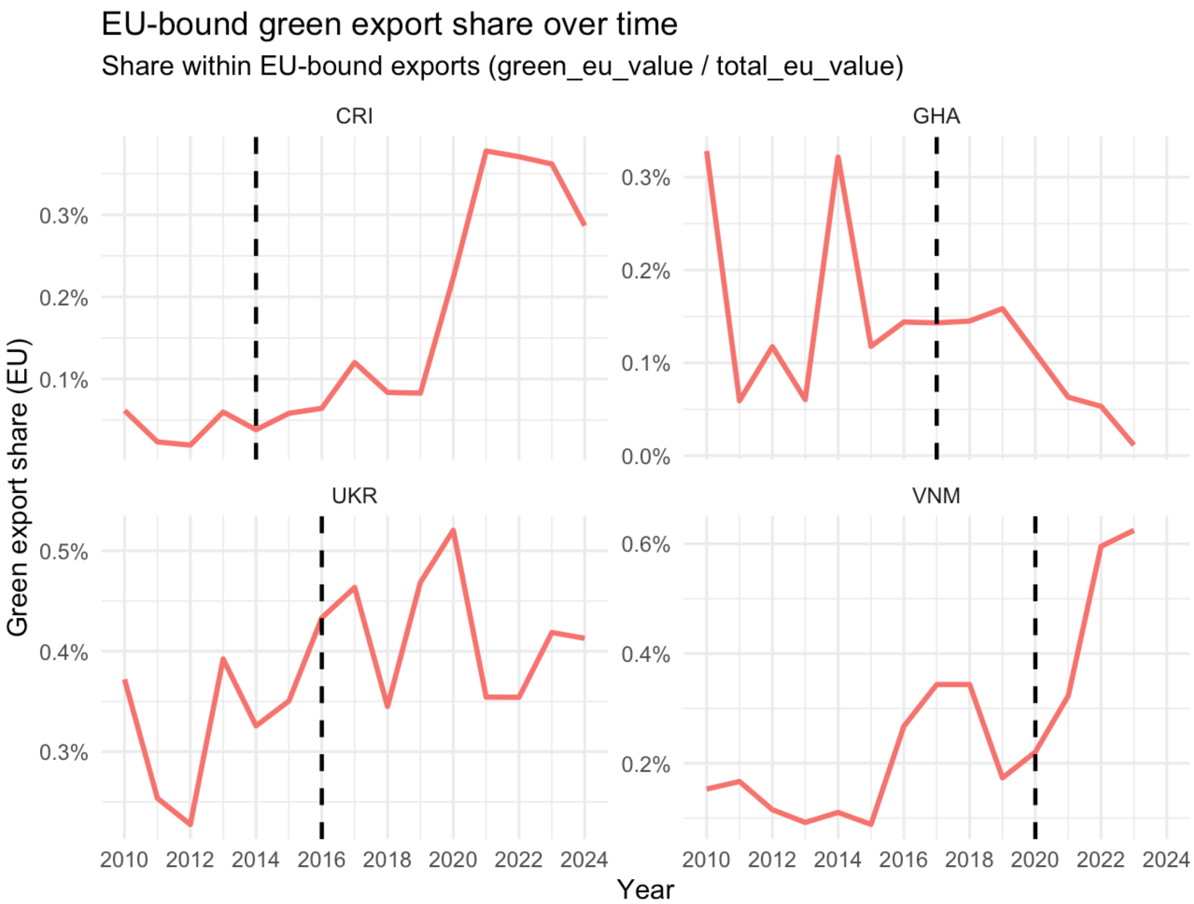

Fig. 5.1b EU-bound green export share over time (Source: UN Comtrade)

element of Hypothesis 1, despite the fact that Vietnam's 'dirty' share (Figure 5.1a) also increases. This suggests that the EU-bound basket can become more 'green' without necessarily becoming less 'dirty', provided that total exports and multiple product groups expand simultaneously. Costa Rica (CRI) also exhibits a noticeable rise in the EU-bound green share after the start year, with elevated levels relative to its very low baseline thereafter.

Second, the remaining cases demonstrate weaker or opposing movements. Ukraine (UKR) shows significant year-on-year volatility, but an overall increase from the mid-2010s onwards, which broadly aligns with the 'greening' narrative of the EU market. However, later years should be interpreted with caution due to geopolitical disruption. In contrast, Ghana (GHA) shows a downward trend in the post-agreement period: after initial fluctuations, the green share steadily declines into the 2020s. This pattern contradicts Hypothesis 1’s expectation of a 'green increase' and will be useful for cross-case comparison later, especially since Ghana’s agreement is comparatively lighter in environmental content.

Taken together, Figure 5.1b provides the second half of the picture of EU-facing adjustments. While some cases (notably Vietnam and Costa Rica) show a clear rise in the green share of EU-bound exports after the agreement came into effect, this is not universal and does not necessarily coincide with reductions in 'dirty' shares. Therefore, the combination of Figures 5.1a and 5.1b motivates the reintroduction of the pre/post summary table and the levels/ scale check. The key question for evaluating Hypothesis 1 is whether the post-period reflects a compositional shift within EU-bound exports, moving away from 'dirty' exports and towards 'green' exports, or whether there is a more mixed adjustment in which green exports increase but 'dirty' exports do not necessarily fall.

To understand if these changes in shares come from genuine movement in products or just a change in EU-bound exports, this table (5.1b) provides a robustness check based on levels for H1. The main H1 evidence uses shares (the green and dirty shares within EU-bound exports). However, a share can change due to either a change in the basket (i.e. a change in the numerator) or a change in the overall scale of EU exports (i.e. a change in the denominator). Reporting EU total exports (scale) alongside EU green export values (numerator) for the pre- and post-period helps to correctly interpret share movements: it shows whether an increase in the EU green share reflects genuine growth in green exports to the EU or simply contraction/expansion of total EU exports.

Table 5.1b suggests that green-share movements are not merely artefacts of the denominator. In Costa Rica, Ukraine and Vietnam, the value of EU green exports increases (CRI: 2.1→7.6 mn; UKR: 53.8→92.4 mn; VNM: 63.8→218.8 mn), indicating that the rise in the EU green share after the reference period reflects genuine growth in green exports to the EU and not just changes in the scale of total EU exports. This is particularly informative for Costa Rica, where total EU exports fall (from 5.18 to 3.73 billion): despite the smaller denominator, the green numerator rises strongly, which reinforces the interpretation of real

Table 5.1b EU-levels pre- and post agreement (Source: UN Comtrade)

country_iso	EU total exports (bn USD) pre	EU total exports (bn USD) post	EU green exports (mn USD) pre	EU green exports (mn USD) post
CRI	5.18	3.73	2.1	7.6
GHA	3.55	2.75	5.2	2.7
UKR	17.06	22.44	53.8	92.4
VNM	31.36	47.52	63.8	218.8

green expansion. In Ghana, by contrast, both total EU exports and EU green export values decline (3.55→2.75 bn; 5.2→2.7 mn), which is consistent with the observed drop in the EU green share. Overall, this check confirms the accuracy of the green results in Table 5.1a[11].
When the share evidence and the levels check are considered together, H1 receives mixed support across cases. Ukraine provides the clearest confirmation of this: the EU-bound 'dirty' share falls sharply while the 'green' share rises. In contrast, Ghana's data suggests that H1 is incorrect: the EU-bound dirty share rises and the green share falls. Furthermore, the levels table confirms that EU green exports also decline in absolute terms. Costa Rica and Vietnam show partial support. EU-bound green shares rise (as do green levels), but EU-bound dirty shares also increase, suggesting that 'greening' in the EU basket can coincide with the growth of dirty exports rather than simple substitution away from dirty products. One plausible contextual factor is the design of the agreement: the TREND data indicates that the EU–West African States agreement (Ghana) contains far fewer environmental provisions (36) than the other three agreements (Vietnam: 122; Central America/Costa Rica: 133; Ukraine: 116), which may limit the strength of environmental expectations and the associated incentives for adjustment (Morin, Dür and Lechner, 2018). This motivates the next step: Section 5.2 shifts its focus from EU-bound shares alone to comparisons and gaps between the EU and RoW, in order to assess whether changes reflect EU-specific sorting/diversion or broader shifts in the country's overall export structure.

5.2 EU–World Composition Gaps and Evidence of Sorting

Section 5.1 documented how the composition of exports to the EU changes at the time of agreement implementation. However, EU-bound shares alone cannot indicate whether these changes are specific to the EU or reflect a broader shift in a country's overall export structure. Therefore, building on the baseline patterns and pre-trends established in Chapter 4, this section moves from within-destination shares to destination gaps. It compares the composition of exports to the EU versus the Rest of the World (RoW) within each country-year.

[11] The same check is less acute for the 'dirty' basket because the 'dirty' trade values are larger and less sensitive to the effects of small denominators.

Figure 5.2a plots the 'dirty' composition gap around each agreement's effective start year (the vertical dashed line), with the post-agreement period shaded.
The interpretation is straightforward: a negative gap indicates that exports to the EU are cleaner in terms of composition (i.e. a lower 'dirty' share), while a positive gap implies that the basket bound for the EU is dirtier than that bound for the Rest of the World (RoW). In the terms used in the theory section, this gap operationalises the destination-based (weak) Brussels Effect. Rather than testing whether production upgrades occur across the entire economy, it tests whether exporters differentiate between destinations by supplying the EU with a systematically different and, in this case, cleaner product mix to that shipped elsewhere. Evidence consistent with such EU-specific sorting would therefore be seen as a more negative dirty gap in the post-period, indicating that the EU-bound basket becomes cleaner relative to the RoW after the agreement comes into effect.

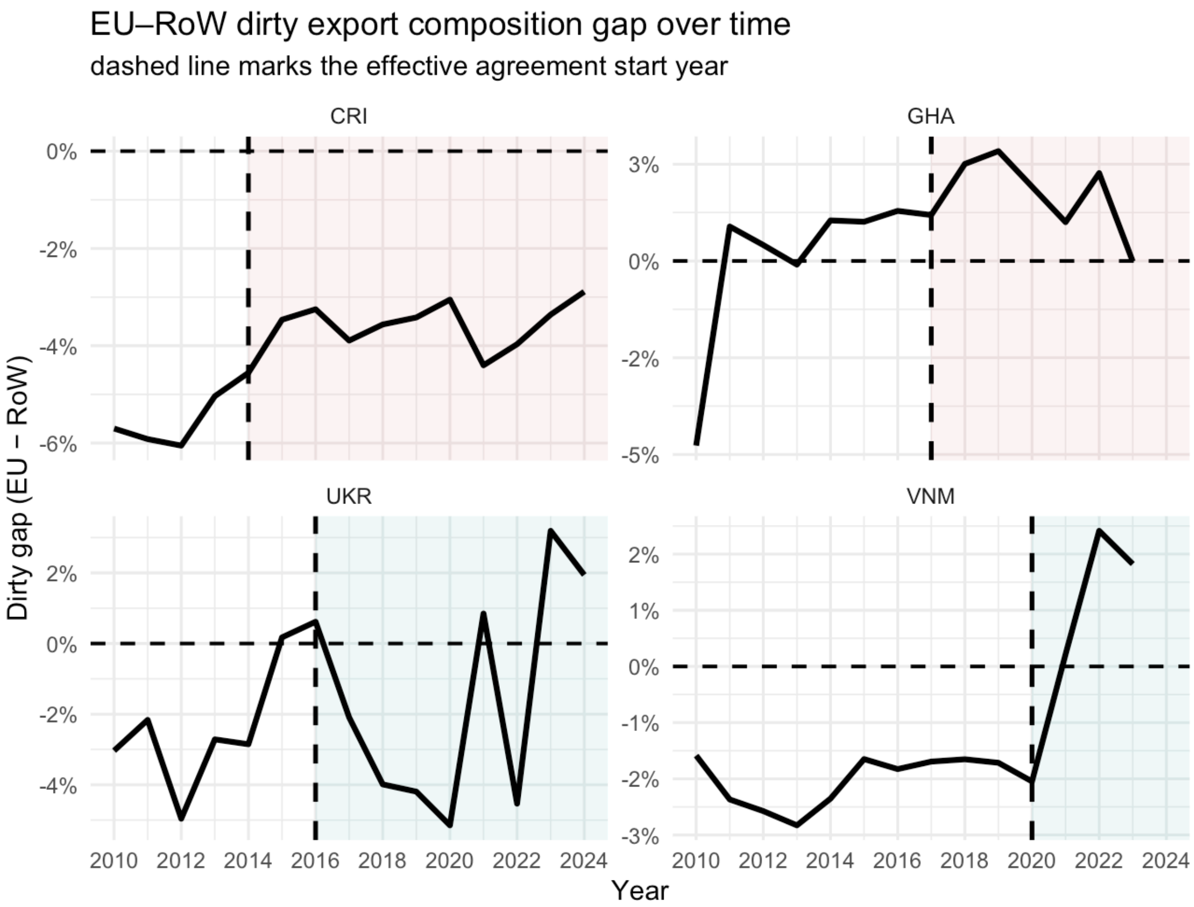

Fig. 5.2a EU-Row dirty export composition gap (post) (Source: UN Comtrade)

The dirty-gap dynamics across the four cases are heterogeneous and do not support a uniform 'cleaning' pattern facing the EU. For Costa Rica, the dirty gap remains consistently negative throughout the sample period, indicating that its exports bound for the EU are consistently cleaner than those bound for the Rest of the World (RoW). However, after the agreement comes into effect, the gap tends to narrow rather than become more negative, suggesting that while the EU basket remains cleaner, the difference in dirtiness between the EU and RoW does not widen as expected under strong destination-specific sorting. For Ghana, the post-period gap is clearly positive for several years, implying that the composition of EU-bound exports becomes dirtier than that of RoW exports. Although the gap later declines towards zero, the overall post-entry pattern contradicts the idea that EU market access and regulatory expectations induce a cleaner EU-directed product mix in the dirty basket. Ukraine displays substantial post-period volatility: there is a phase in which the dirty gap becomes more negative, indicating an EU-bound basket that is cleaner than the rest of the world (RoW), but this pattern is not stable over time and later reversals dominate. Given the overlap with major geopolitical shocks, these swings should be interpreted cautiously as descriptive changes in destination-specific composition rather than being attributed to agreement-driven sorting. Finally, Vietnam exhibits a notably sharp reversal: a relatively stable negative 'dirty gap' in the pre-period transforms into a significantly positive gap after the agreement commences, suggesting that the EU-bound basket becomes dirtier relative to the Rest of the World (RoW) in the post-period. Figure 5.2a therefore suggests that, while some cases show persistently cleaner EU-bound baskets or episodic post-entry improvements, EU-specific cleaning of the dirty basket is not a consistent pattern across cases. This motivates a comparison with the green-gap evidence and the section's summary table, in order to assess whether the observed adjustments reflect destination-based sorting, broader structural change or instability driven by shocks.

Figure 5.2b plots the same gap for the green composition. A positive gap indicates that the composition of the EU-bound basket is greener (i.e. it has a higher green share) than that of the RoW basket, while a negative gap suggests that exports to the EU are less green than those to RoW. Evidence of EU-specific greening would be evident in the post-period as the green gap becomes more positive.

The patterns are heterogeneous once again, but the green gap evidence somewhat more strongly supports EU-specific greening in two of the cases. For Costa Rica, the green gap is clearly negative in the pre-period, indicating that exports bound for the EU were initially less environmentally friendly than those bound for the Rest of the World (RoW). However, it rises steadily in the later post-period and turns positive from around 2020 onwards. This suggests a meaningful change in the relative composition, with the basket destined for the EU becoming greener than that destined for RoW after a lag. This is consistent with the gradual emergence of destination-specific adjustments rather than an immediate break at entry. Ghana shows an increase into mildly positive territory at the start of the period, but this improvement is not sustained; the green gap subsequently trends back towards zero and slightly below, implying that any EU-specific greening relative to RoW is weak or temporary. For Ukraine, the green gap remains negative throughout, but exhibits clear upward movement over time, approaching zero by the end of the sample period. This suggests that the EU-bound basket is becoming progressively greener relative to RoW, although caution

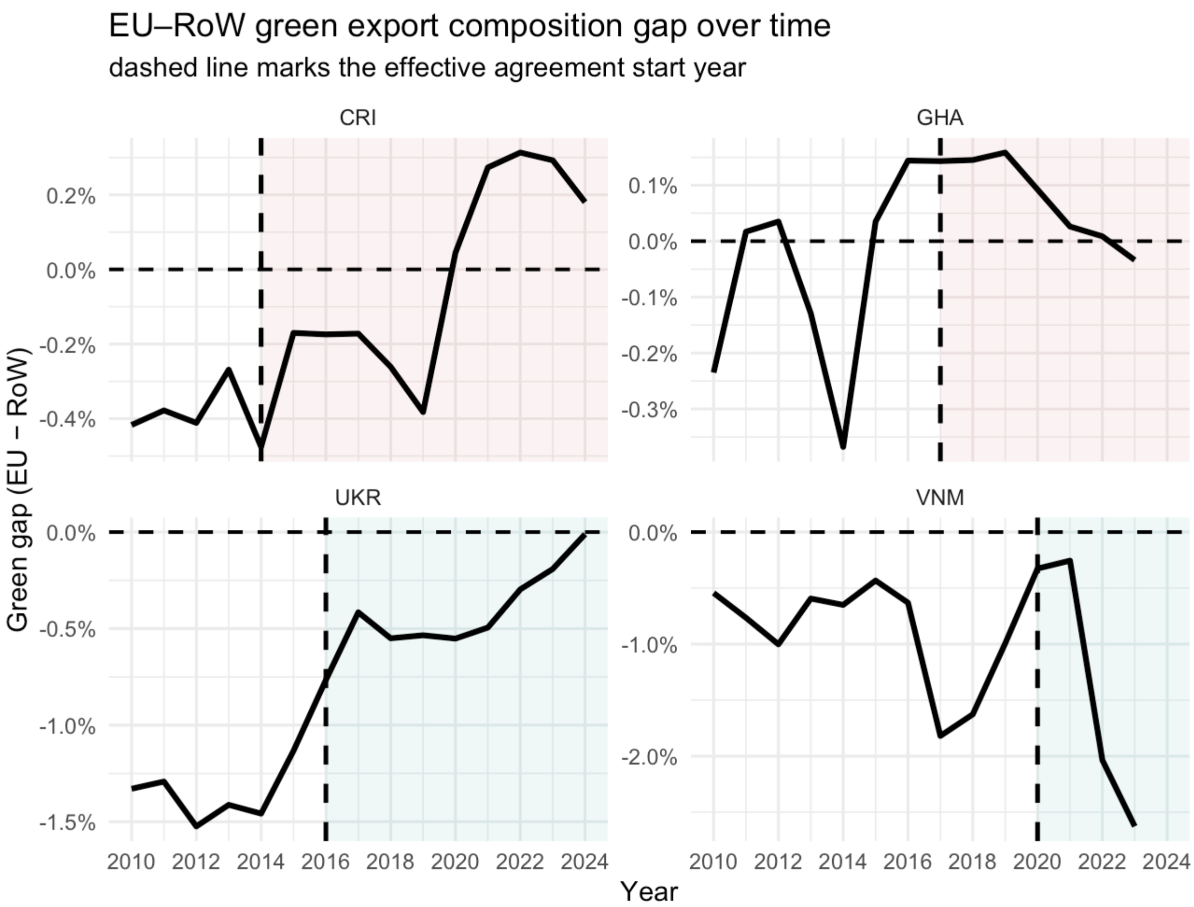

Fig. 5.2b EU-Row green export composition gap (post) (Source: UN Comtrade)

should be exercised in interpretation given the overlap with major shocks that may affect destinations differently. Finally, Vietnam displays the clearest divergence from the weak Brussels Effect prediction: the green gap is negative before entry and becomes increasingly negative in the post-period, particularly in later years. This implies that EU-bound exports become less green relative to RoW exports.

Table 5.2 summarises the gap evidence by collapsing the time series into pre- and post-agreement averages. The results confirm the heterogeneity visible in Figures 5.2a and 5.2b, and provide a concise test to determine whether EU-facing adjustment occurs in the form of destination-specific sorting, which is consistent with a weak (destination-based) Brussels Effect. For the dirty basket, the change in the EU–RoW gap is positive in all four cases: Costa Rica's dirty gap shifts from −5.68 percentage points (pp) to −3.62 pp (Δ = +2.06 pp);

Table 5.2 pre- and post- gaps (Source: UN Comtrade)

country_iso	start_year	pre_years	post_years	n_pre	n_post	Dirty gap (pre, pp)	Dirty gap (post, pp)	Δ Dirty gap (pp)	Green gap (pre, pp)	Green gap (post, pp)	Δ Green gap (pp)
CRI	2014	2010-2013	2014-2024	4	11	-5.68	-3.62	2.06	-0.37	-0.05	0.32
GHA	2017	2010-2016	2017-2023	7	6	-0.03	1.63	1.66	-0.07	0.07	0.15
UKR	2016	2010-2015	2016-2024	6	9	-2.59	-1.48	1.11	-1.36	-0.42	0.93
VNM	2020	2010-2019	2020-2023	10	4	-2.02	0.6	2.63	-0.91	-1.31	-0.41

Ghana's shifts from −0.03 pp to +1.63 pp (Δ = +1.66 pp); Ukraine's shifts from −2.59 pp to −1.48 pp (Δ = +1.11 pp); and Vietnam's shifts from −2.02 pp to +0.60 pp (Δ = +2.63 pp). As a more negative dirty gap would suggest that the EU-bound basket is becoming cleaner in comparison to RoW, these shifts imply that, on average, the EU-bound basket is becoming less clean in comparison to RoW in the post-period, most notably for Ghana and Vietnam, where the gap has turned positive.

For the green basket, the evidence is more mixed and therefore provides more information about EU-specific greening. Costa Rica's green gap narrows significantly (from −0.37 pp to −0.05 pp; a change of +0.32 pp), while Ghana's turns slightly positive (from −0.07 pp to +0.07 pp; a change of +0.15 pp). Ukraine's green gap also improves substantially (from −1.36 pp to −0.42 pp; a change of +0.93 pp). These changes suggest that the EU-bound basket is becoming greener than the RoW basket, although in Costa Rica and Ukraine, the post-average remains close to (or below) zero, indicating gradual convergence rather than a decisive change. However, Vietnam stands out as an exception, with its green gap becoming more negative (from −0.91 pp to −1.31 pp; Δ = −0.41 pp), indicating that its exports to the EU become less green relative to those to other regions after entry.

Taken together, evidence of the EU–RoW gap provides only limited and highly heterogeneous support for EU-specific sorting. In the 'dirty' basket, the post-period does not show a systematic shift towards a more negative gap. Instead, the 'dirty' gap generally moves towards zero or becomes positive. This implies that the basket bound for the EU becomes less clean in terms of composition relative to RoW.

In the green basket, the picture is more nuanced. Costa Rica and Ukraine exhibit a clear improvement over time, consistent with the EU-bound basket becoming greener relative to RoW, while Ghana's progress is weak and inconsistent, and Vietnam's green gap deteriorates.

Interpreted through the lens of the destination-based (weak) Brussels Effect, these findings suggest that market-specific adjustment is not a uniform outcome of EU agreements. Where it does occur, it is more evident in the green basket than the dirty basket, often emerging gradually rather than immediately at the start of the agreement. This variation across cases motivates a shift from documenting patterns to explaining why the same EU-facing framework is associated with divergent adjustment trajectories.

5.3 Explaining heterogeneity: agreement depth, implementation, and shocks

Section 5.3 expands upon the cross-case comparison. Sections 5.1 and 5.2 documented the evolution of EU-bound export composition and EU–RoW destination gaps around the time of agreement entry. They also showed that adjustment patterns differ markedly across Costa Rica, Ghana, Ukraine and Vietnam. Explaining this heterogeneity is central to the comparative logic of the thesis: if the destination-based (weak) Brussels Effect operates

through market-specific incentives and expectations, then the strength and timing of EU-facing adjustment should plausibly vary according to the institutional and policy context in which each agreement is embedded. Accordingly, this section evaluates whether the observed variation aligns with differences in:
(i) the scope of environmental content in each agreement;
(ii) implementation and operationalisation over time; and
(iii) time dynamics and external shocks that can independently shape trade composition.
The objective is not to attribute changes to single causes, but rather to provide a structured interpretation of why similar EU-facing governance frameworks are associated with different adjustment trajectories across cases. This will motivate the more focused case discussions that follow.

5.3.1 Toolkit for interpreting heterogeneity across cases

This thesis uses a comparative strategy to distinguish between two broad types of change. A strong (global) Brussels Effect would imply greater convergence in production practices or regulations affecting exports to all destinations. In contrast, the destination-based (weak) Brussels effect that can be measured using trade data refers to market-specific adjustments: exporters differentiate between destinations, supplying the EU with a different product mix to that supplied to the rest of the world. In this context, the key empirical question is not whether EU rules 'upgrade' production across the economy, but whether incentives and expectations facing the EU are reflected in destination-specific sorting of export composition.
To explain why such sorting appears stronger in some cases than in others, I use four complementary approaches.
The first is the environmental scope of agreements (i.e. their depth). Agreements differ substantially in how extensively they reference environmental objectives, cooperation mechanisms and governance provisions. The thesis uses the TREND database to capture this as a transparent proxy for the breadth of environmental content. This measure is useful for making comparisons because broader environmental coverage can make environmental expectations more prominent and credible, even though it does not capture legal enforceability or stringency by itself.
The second lens is implementation credibility and timing. Even when the legal text is similar, agreements can differ in terms of how quickly and effectively provisions are implemented. Staged implementation, administrative capacity constraints or delays in operational procedures can reduce the practical relevance of market access and governance commitments. For a destination-based mechanism, where firms respond to incentives and expectations associated with EU market participation, implementation affects the timing and credibility of observable adjustments.
Thirdly, I consider external shocks and policy overlays that can independently alter the composition of trade. Significant shocks, such as conflict, commodity price cycles or

pandemic-related disruptions, can dominate the evolution of export baskets and affect EU and RoW destinations differently. During such periods, changes in the EU–RoW gap should be interpreted with caution as they may reflect shifts in demand, logistics or emergency trade measures rather than destination-based sorting driven by expectations related to agreements.

Finally, I incorporate time dynamics. The theory section emphasises that adjustment can be immediate or gradual. In the short term, exporters can respond by sorting and switching destinations, reallocating products across markets without changing production technology. Deeper changes, if they occur, tend to emerge only over time, as firms learn, invest and reorganise their capabilities. This implies that a destination-based effect may manifest as delayed divergence in EU–RoW gaps rather than a sharp break at the start of the agreement year. This motivates attention to whether changes persist, strengthen or dissipate over time.

Together, these four perspectives offer a coherent approach to understanding why the same EU-facing policy framework can result in different adjustment trajectories across cases. The next subsection summarises these dimensions and applies them systematically to the observed patterns from Sections 5.1 and 5.2 before turning to more detailed case discussions.

5.3.2 Cross-case interpretation

Table 5.3.2 summarises the contextual dimensions implied by the toolkit for each case, providing a concise reference for the subsequent comparative analysis.

For Costa Rica, Ghana, Ukraine and Vietnam, it summarises the agreement's effective start year and an indicator of environmental scope based on TREND environmental provision counts. It also provides key notes on implementation and credibility, as well as major external shocks or policy overlays that may independently influence trade composition.

Presenting these elements side by side makes the logic of the cross-case comparison transparent, evaluating heterogeneous patterns in EU-facing adjustment against heterogeneous institutional and contextual conditions rather than reading them as isolated, country-specific anomalies. This framework also operationalises the remaining hypotheses in a comparative manner. H3 (agreement depth) is evaluated by examining whether cases with broader environmental content (as indicated by TREND provision counts) demonstrate stronger or more consistent divergence between the EU and RoW. H4 (time dynamics) is evaluated by determining whether destination-specific adjustments occur immediately around the effective start year (consistent with short-run sorting/diversion), or only with a delay (consistent with slower-moving restructuring).

The remainder of this subsection applies the same interpretive sequence to each case. For each country, I first reiterate the key empirical patterns identified in Sections 5.1 and 5.2, namely changes in EU-bound composition and the evolution of EU–RoW gaps. I then interpret these patterns using the four lenses, agreement depth, implementation timing and

Table 5.3.2: Context matrix for interpreting cross-case heterogeneity (Author's own compilation)

Case	Agreement (EU partner)	Baseline start year	TREND Env. Provisions	Implementation/ credibility notes	Major shocks/ policy overlays	Expected timing
GHA	Ghana-EU interim EPA (within West Africa EPA framework)	2017	36	Low environmental scope; staged/ delayed operational milestones reported in official communications.	COVID-era disruption; commodity-cycle sensitivity	Limited/weak; timing potentially delayed.
UKR	EU-Ukraine Association Agreement / DCFTA	2016	116	Deep integration setting; interpretation depends on separating agreement period from subsequent shock regimes.	Major geopolitical shocks (2014; 2022+) and exceptional trade measures.	Short-run patterns may be confounded; treat regimes separately
CRI	EU-Central America Association Agreement (trade pillar)	2014	133	Long-standing framework; adjustment may be gradual rather than immediate at entry.	COVID-era trade disruption (2020-21).	More likely gradual (lagged) change.
VNM	EU-Vietnam Free Trade Agreement (EVFTA)	2020	122	New agreement; potential for short-run sorting with longer-run adjustment only emerging over time.	COVID-era disruption around entry; sectoral policy overlays	Short-run sorting plausible; longer-run effects may lag.

credibility, external shocks and policy overlays, and time dynamics, before concluding with a brief assessment of whether the observed trajectory is consistent with destination-based sorting, as implied by a weak Brussels Effect.

5.3.3 Ghana low agreement depth and staged implementation

For Ghana, the quantitative results in Sections 5.1–5.2 suggest weak and partly counter-directional evidence of destination-specific adjustment. In H1, Ghana's EU-bound dirty share rises while the EU-bound green share declines. In the EU–RoW comparison (H2), the dirty composition gap shifts from neutral to positive in the post-period, implying that Ghana's EU-bound basket becomes relatively dirtier than its RoW basket. Meanwhile, the green gap shows only minor improvement. Interpreted through the lens of the destination-based (weak) Brussels Effect, this pattern does not suggest sustained 'EU-specific cleaning' via sorting. Instead, it indicates that Ghana's exports to the EU did not systematically shift towards a cleaner product mix compared to exports shipped elsewhere.

Table 5.3.2 illustrates why Ghana may be an intrinsically challenging case for achieving strong destination-based effects. Firstly, regarding agreement scope (H3), although Ghana is linked to the broader EU–West Africa EPA framework, the regional EPA is not applied; instead, trade relations operate through a 'stepping-stone' interim EPA (European Commission, 2025a). Using the TREND-based coding system employed in this thesis, Ghana's agreement has the fewest environmental provisions (36), implying a substantially

narrower set of environmental references and governance provisions than the other agreements, and consequently a weaker basis for sustained regulatory expectations (Morin, Dür and Lechner, 2018). The interim EPA architecture itself also underscores the primacy of market access and the logic of gradual liberalisation: EU materials describe permanent duty-free, quota-free access for Ghana under the interim framework, as well as an asymmetric, gradual liberalisation structure on the West African side(European Commission, 2025a).
Secondly, regarding implementation credibility and timing, the EU and Ghana's joint statement provides a concrete institutional timeline that clarifies why 'post' dynamics may not align neatly with a single break year. It confirms that the interim EPA has guaranteed Ghana duty-free, quota-free access to the EU market since December 2016. However, it also notes that implementation milestones were delayed, and that 1 July 2021 marks the start of 'effective implementation by Ghana', including the operationalisation of systems and documents (e.g. rules of origin documentation) linked to implementing tariff schedules (European Commission, 2021).
Thirdly, the structure of Ghana's exports makes it particularly vulnerable to external shocks and commodity cycles, which can mechanically alter the composition of exports and create gaps, even in the absence of policy-driven adjustments. World Bank diagnostics highlight that Ghana's exports are concentrated in a small set of commodities, especially gold, cocoa and oil, and explicitly link this concentration to vulnerability to external shocks and movements in world market prices (Kwakye, Kimani and Elmaleh, 2024). This is important when interpreting the gap patterns, as commodity price and volume fluctuations can alter the relative importance of 'dirty' categories (e.g. fuels and extractives) in total exports, affecting EU and RoW destinations differently depending on demand conditions, logistics, and buyer composition. Finally, from a time-dynamics (H4) perspective, Ghana combines a low-depth environmental agreement signal with a staged implementation narrative and a commodity-exposed export base. Therefore, a strong immediate post-entry sorting response is not the most plausible scenario: if any destination-based effect exists, it may be muted or delayed, or it may be overshadowed by broader, commodity-driven variation.

Taking all these factors into account, it is best to interpret Ghana as a case of low depth, implementation friction and commodity sensitivity, in which the descriptive trade evidence provides little support for a destination-based Brussels Effect in the strict sense of EU-specific cleaning. From an analytical perspective, this is useful for the comparative argument as it suggests that limited environmental scope and institutional credibility, combined with an export structure that is less susceptible to rapid compositional shifts, may explain why the Ghana case does not exhibit the same type of EU–RoW divergence that would be anticipated under strong destination-specific sorting.

5.3.4 Ukraine: Deep integration under a wartime shock regime

For Ukraine, the quantitative results in Sections 5.1–5.2 demonstrate the most significant changes in the EU-facing composition indicators. However, they also illustrate why interpretation must explicitly consider shocks and policy overlays. In EU-only trends (H1), Ukraine is the strongest case for a 'cleaning/greening' narrative: the share of dirty products bound for the EU declines markedly while the share of green products bound for the EU rises. In the EU–RoW comparison (H2), the green composition gap steadily improves over time (moving closer to zero), which is consistent with the EU-bound basket becoming greener relative to the rest of the world. However, the dirty gap is notably volatile and does not trace a stable post-entry path. This combination of clear movement in the green indicators and instability in the dirty gap suggests that multiple forces are acting on Ukraine's export composition simultaneously.

From the perspective of the comparative toolkit, Ukraine is a 'high-scope' case under H3. The EU–Ukraine Deep and Comprehensive Free Trade Area (DCFTA) has been provisionally applied since 1 January 2016 as part of the broader Association Agreement framework (European Commission, 2025c). In a destination-based (weak) Brussels Effect framework, this type of deep integration creates a situation in which EU-facing incentives and expectations could plausibly generate market-specific sorting. This is particularly likely given that the DCFTA is based on predictable and enforceable trade rules and a broad approximation agenda (European Commission, 2025c). Therefore, at face value, the fact that Ukraine shows the largest 'EU-facing' decline in dirty shares is compatible with the hypothesis that deeper agreements can be associated with stronger EU-facing adjustment.

However, Ukraine is a case in which external shocks and policy overlays most clearly confound any straightforward interpretation of timing based on agreements. The most significant of these is the wartime regime that has been in place since 2022, which has fundamentally reshaped production, logistics and trade routes. The World Bank's Rapid Damage and Needs Assessment documents the scale of transport disruption caused by restricted access to Black Sea ports, which accounted for the majority of losses in the transport sector and severely constrained Ukraine's export logistics (The World Bank, 2025). As EU–RoW gaps are partly determined by the ability to physically deliver goods to different markets, such disruptions can generate destination-specific shifts in composition that are not driven by agreements. In parallel, EU trade policy itself changed under emergency conditions: the EU adopted and repeatedly renewed Autonomous Trade Measures (ATMs) that suspended outstanding customs duties and quotas for Ukrainian exports under the DCFTA framework (with safeguard mechanisms) (European Council, 2024). These measures are explicitly temporary and crisis-driven, and they can alter the EU's effective market access conditions relative to other destinations in ways that are analytically distinct from the original DCFTA implementation path. This is why Table 5.3.2 identifies Ukraine as a case where 'short-run patterns' are particularly complicated. After 2022, observed movements in the composition gap between the EU and the Rest of the World (RoW) can reflect wartime supply and logistics constraints, rerouting away from blocked or damaged export channels, and exceptional EU trade facilitation, rather than a gradual, expectations-driven, destination-based Brussels Effect. Therefore, a careful reading of the trade evidence requires an interpretation that considers the context of the regime: where the green gap improves gradually and persistently over a longer period, this can be interpreted as consistent with EU-facing adjustment. However, where the dirty gap is unstable in the post-period, the most defensible interpretation is that the indicator is picking up overlapping shock dynamics and emergency policy overlays rather than a single, coherent sorting response. Therefore, when drawing conclusions about destination-based sorting in the Ukrainian case, it is advisable to treat the post-2022 period as analytically distinct.

5.3.5 Scope conditions and confounding shocks: Lessons from Ghana and Ukraine

Even if they are less suitable for a detailed, mechanism-oriented deep dive, Ghana and Ukraine remain essential to the comparative logic of the thesis. As comparison cases, they expand the range of agreement designs and export structures examined in the analysis. Ghana is at the low end of the spectrum, with fewer environmental provisions than the other agreements and a relatively exposed export structure to commodity-driven fluctuations. Ukraine, by contrast, is embedded in a deep integration framework under the DCFTA, featuring a very different export profile that includes a high baseline share of emissions-intensive goods. Together, these two cases therefore strengthen the cross-case test of heterogeneity, ensuring that observed EU-facing adjustment patterns are evaluated across meaningfully different institutional settings and production structures, rather than within a narrow 'most similar' set.

At the same time, both cases impose clear limitations on a more in-depth process tracing exercise attempting to link changes in trade composition to particular policy mechanisms. In Ghana, the combination of a limited environmental scope of the agreement and a staged implementation trajectory undermines the plausibility of a robust destination-based adjustment channel, making it more difficult to interpret short-term changes in gaps as reflecting EU regulatory expectations rather than broader volatility. In Ukraine, the interpretive challenge is even more pronounced: the pre-DCFTA period was affected by the 2014 Crimea-related shock, while the post-2022 period constitutes a distinct wartime regime involving severe disruption and exceptional policy overlays that can influence trade composition independently of agreement dynamics. This does not render Ghana or Ukraine analytically unimportant, but rather implies that additional within-case evidence would struggle to distinguish between mechanisms related to the agreement and confounding implementation frictions and large shocks.

Together, Ghana and Ukraine expand the scope of the comparison and clarify the conditions under which EU-facing 'greening' is most difficult to detect in compositional data, either because governance is weak and commodity-driven volatility dominates, or because major shocks overwhelm gradual adjustment channels. The remainder of the chapter therefore focuses on Costa Rica and Vietnam, where the institutional setting is more stable and product-level evidence can be used to trace the sources of divergent patterns between the EU and the rest of the world.

6. Tracing heterogeneity: why Costa Rica and Vietnam diverge

This section provides a more detailed interpretation of the aggregate EU–RoW indicators by cross-checking them with two types of evidence from within the case studies of Costa Rica and Vietnam. Firstly, the pre/post changes in the dirty and green baskets are decomposed into the HS6 categories that contribute most to the observed movements (Appendix Table A.3). This clarifies whether the gap dynamics are driven by a small number of product lines or by broader compositional shifts. Secondly, a concise timeline of domestic and EU-relevant policy milestones is overlaid to assess whether the timing of changes is plausibly aligned with evolving incentives and constraints. The aim is not to identify causation, but to interpret mechanisms consistently: to evaluate whether the direction and sequencing of changes fit destination-based (weak) Brussels Effect logic, meaning market-specific sorting under credible expectations or whether alternative explanations (sectoral shocks, implementation sequencing, external constraints) better account for the patterns.

6.1 Costa Rica deep dive: policy expectations and product-level drivers

Costa Rica is an ideal case for a detailed analysis because it combines a relatively stable interpretive setting with a clear domestic climate policy trajectory that can influence long-term expectations. Costa Rica has been covered by the trade pillar of the EU–Central America Association Agreement since 1 October 2013 (treated as effective from 2014 in this thesis) (European Commission, 2013). Domestically, Costa Rica's National Decarbonisation Plan 2018–2050 explicitly sets out a net-zero-by-2050 goal and outlines implementation in three phases (foundations, inflection and mass deployment) (Government of Costa Rica, 2018). This implies that, if it occurs, any compositional adjustment may emerge gradually rather than as an immediate discontinuity at the start of the agreement. This longer-term orientation is reinforced by sectoral policies such as Law 9518 on electric transport incentives, which establishes a multi-year framework rather than a one-off reform (Grantham Research Institute, 2026c).

To clarify the underlying factors contributing to the aggregate 'dirty' and 'green' indicators, Appendix Table A.3 reports the leading HS6 codes in each category by destination (EU vs. RoW) and period (pre vs. post). Two features stand out for Costa Rica. Firstly, the EU-bound 'dirty' basket is extremely small and concentrated, whereas 'dirty' exports to RoW are much larger. During the pre-period, Costa Rica's EU 'dirty' basket was dominated by a limited number of metal inputs, such as HS 760711 (aluminium foil), HS 720260 (ferro-nickel) and HS 760720[12] (aluminium foil 'backed'), while the RoW 'dirty' basket was led by steel- and fertiliser-related codes (e.g. HS 721041, HS 721420 and HS 310590). This asymmetry in scale between destinations implies that changes in Costa Rica's share of dirty exports to the EU or its dirty gap can be driven by small changes at the product level in a narrow EU basket, rather than by a broad reallocation of emissions-intensive production.

Secondly, although the EU's 'dirty basket' remains small, its internal composition changes during the post-period. The leading EU 'dirty' codes have shifted away from aluminium and inputs towards iron and steel articles, such as HS 732620 (articles of iron or steel wire), HS 732690 (other articles of iron or steel) and HS 730441 (steel tubes and pipes). Meanwhile, the corresponding RoW dirty basket continues to be dominated by steel products (e.g. HS 721420 and related iron and steel lines). Overall, the post-period evidence suggests a reorganisation within the dirty basket on a small EU margin, rather than a large-scale 'dirtying' or 'cleaning' of Costa Rica's exports to the EU.

On the green side, the HS6 pattern is more consistent with an EU-facing machinery/ instruments profile. In the pre-period, Costa Rica's EU green basket was dominated by machinery parts[13] (notably HS 841199 and HS 842199), while the RoW green basket was led by measuring/checking instruments (HS 903289) and electrical equipment parts (HS 854390). During the post-period, EU green exports were dominated by high-specification analytical and precision equipment, such as gas or smoke analysis apparatus (HS 902710), spectrometers/spectrophotometers (HS 902730), and machines with individual functions (HS 847989). These categories are technology- and compliance-intensive, aligning naturally with Costa Rica's broader trajectory of upgrading in advanced manufacturing. This includes the documented expansion and diversification of exports of medical devices and other sophisticated equipment since 2014 (USITC, 2024).

A key interpretive question is whether this 'greening' reflects an economy-wide shift towards higher-value exports to all destinations, or whether it reflects a shift towards the EU that is consistent with a weak Brussels Effect. In order to distinguish between these two mechanisms within the descriptive framework, I examine the share of the EU within the HS6 lines that dominate Costa Rica's green basket post-period. For HS847989, HS902710 and HS902730, the EU share increases sharply from around 5–8% in the pre-period to 54–61% in the post-period. This is driven by substantial growth in EU-bound values (in the millions of USD) alongside flat or declining RoW values. This pattern suggests that Costa Rica's post-

[12] HS 760711 is plain aluminium foil. HS 760720 is 'backed', meaning it is supported by another material, such as paper, for use in packaging, etc.

[13] For the rationale underlying the 'green' HS6 classification and the item-level notes, see the APEC Environmental Goods List (APEC, 2025).

period green signal is not merely an expansion of these product lines across destinations, but rather a significant shift in the export of these products towards the EU. In this sense, the Costa Rican evidence is consistent with destination-based sorting on the green margin. However, the absolute scale of these flows remains modest, and HS6 categories cannot identify end use with certainty. Therefore, the result should be interpreted as EU-facing compositional sorting within a standard environmental goods classification rather than as definitive evidence of production-side upgrading.

6.1.1 Costa Rica policy timeline and expectations

To interpret Costa Rica’s post-period, EU-facing 'greening' signal, especially the increase in EU market share for HS84/HS90 machinery and precision instruments, it is helpful to consider credible, staged domestic decarbonisation commitments alongside external EU regulatory tightening. The idea is that Costa Rica is less likely to show an immediate, one-off increase at the start of the agreement, and more likely to exhibit gradual or lagged compositional change as expectations become more realistic and investment and production networks mature. Costa Rica’s export adjustment should be interpreted against the backdrop of policies that predate the EU-Central America Association Agreement by many decades and are explicitly framed as a gradual transition. This is important for understanding the timing of responses in the trade sector: if firms base their expectations on the credibility of long-term policies and staged implementation, changes in the composition of exports (especially in 'green' HS categories) are less likely to be apparent immediately after the agreement comes into effect and are more likely to build up over time.

The first pillar is Costa Rica’s earlier conservation and nature-based policy model. Reforms to forest governance and the expansion of conservation incentives culminated in the Payment for Ecosystem Services (PES) approach. This was introduced with a new Forest Law in the late 1990s and is financed via a fossil-fuel tax. The PES approach is frequently described as a core institutional innovation behind the country’s reforestation and conservation trajectory and was supported by credible and effective institution building, like the Ministry of Environment and Energy (MINAE) or FONAFIFO the National Fund for Forest Finance (Campos, 2025).

These policies are analytically relevant because they demonstrate that the 'greening' of Costa Rica did not begin with the EU agreement; rather, the agreement builds upon an existing domestic trajectory, which is useful context when assessing whether post-2014 changes reflect EU-facing sorting or broader upgrading.

A second pillar is the trade-policy anchor. The trade pillar of the EU–Central America Association Agreement applied provisionally from October 2013; in this thesis the effective start is operationalised as 2014. In expectation terms, the agreement strengthens the credibility of EU market access and can raise the salience of EU regulatory standards for

exporters, but its effect on export composition may still be slow-moving if complementary domestic policy and investment cycles are gradual (European Commission, 2013).
A third pillar is the sequence of energy and transport policies that makes 'gradual/lagged' adjustments particularly plausible. Costa Rica’s National Energy Plan 2015–2030 establishes a compulsory planning framework for public institutions based on 'sustainable energy with a low level of emissions', explicitly highlighting the transport sector as central to decarbonisation. This was followed by a significant, albeit multi-year, push in the transport sector: in December 2017, the legislature passed Law No. 9518 on incentives and promotion for electric transport, which came into effect in May 2018. The law also mandated the creation of a National Electric Transportation Plan, published in early 2019 (Skowron, van Riet and Martinez, 2020).
Conceptually, this kind of sequencing supports a lag structure: incentives and plans first change investment and procurement expectations, while observable shifts in HS6 export composition only follow once supply chains, capabilities and product mixes have adjusted.
Finally, the timeline concludes with the launch of the National Decarbonisation Plan for 2050 in February 2019. The plan explicitly targets a net-zero economy by 2050, setting out implementation steps and sectoral packages (transport/mobility, energy/buildings/industry, waste, agriculture/land-use/nature-based solutions) alongside cross-cutting measures such as financial mobilisation and metrics systems (Government of Costa Rica, 2018).

In terms of the trade analysis, the key implication is that the period after 2019 (especially following the transport policy of 2018/2019) is a more plausible timeframe for accelerated adjustment signals than the year in which the agreement came into effect. This is consistent with the idea that Costa Rica's patterns are the result of the interaction between EU-facing incentives and a long-term, domestic decarbonisation strategy, rather than a one-off policy shock when the agreement came into force.
Costa Rica’s in-depth analysis suggests that the post-period patterns are best understood as the result of the interaction between (i) Costa Rica's long-standing 'green state' trajectory and (ii) market incentives facing the EU, rather than as an immediate, one-off compositional shift triggered solely by the Association Agreement. Costa Rica’s environmental governance and conservation institutions had already been consolidated by 2014, making it implausible to attribute the country’s overall 'greening direction' to the EU agreement.
Instead, the agreement is more plausibly linked to destination-specific adjustments. At the product level, the green basket becomes dominated by machinery and analytical/precision instruments (HS84/HS90-type lines) after the agreement, and the EU's share of the key HS6 driver codes rises sharply from single-digit pre-period levels to roughly half or more in the post-period, indicating a pronounced reorientation of these exports towards the EU rather than parallel growth across destinations.
The policy timeline strengthens the 'gradual expectations' interpretation. Costa Rica's staged decarbonisation strategy and multi-year sectoral policies (notably in transport) provide a

credible long-term direction of travel that would be expected to influence export capabilities with a lag. This aligns more naturally with post-2018/2019 dynamics than with an immediate effect at the start of the agreement.

Within the descriptive framework of this thesis, therefore, the evidence from Costa Rica supports a weak Brussels Effect based on destination: the EU appears to influence where certain 'green-classified' product lines are shipped, while Costa Rica's national strategy and institutions plausibly influence the capability base that enables such exports. However, because HS6 categories are often dual-use and values remain modest in absolute terms, this should be interpreted as evidence of EU-facing sorting within the export basket rather than as definitive proof of production-side upgrading.

The next section applies the same product-driver and EU-share logic to Vietnam. Here, the timing of the agreement is later, and the sequence of domestic environmental regulations is different. This allows a clearer comparison of time dynamics and policy overlays.

6.2 Vietnam deep dive: policy expectations and product-level drivers

Vietnam is a strong candidate for a detailed analysis because the EVFTA is a comparatively comprehensive sustainability agreement (based on TREND-based counts, it is one of the most provision-dense agreements in this sample with 122 environmental provisions) and because the post-2020 period coincides with a noticeable tightening of domestic climate and environmental governance, which could plausibly influence exporters expectations over time. The EU–Vietnam FTA came into effect on 1 August 2020, firmly embedding Vietnam within the EU's market access and regulatory ecosystem (European Commission, 2025d). At the same time, Vietnam adopted and began implementing an updated domestic environmental policy framework. The Law on Environmental Protection (No. 72/2020/QH14), passed in November 2020, came into effect on 1 January 2022 (Grantham Research Institute , 2026a). This was followed by implementing decrees that operationalised licensing, standards and climate-related provisions. In parallel, Vietnam's leadership publicly committed to a long-term policy anchor by announcing a net-zero target for 2050 at COP26 (Phạm, 2021).

In order to determine whether the patterns observed in Vietnam's exports after the transition period reflect a weak Brussels Effect (EU-facing sorting) or a broader export upgrading, I supplement the HS6 'top codes' (in Appendix Table A.3) decomposition with an additional diagnostic. This involves calculating the EU share within each key HS6 line by dividing EU exports of the HS6 code by the total exports of the same code (EU + RoW). This is then compared across the pre- and post-period. On the dirty side, the CBAM-scope diagnostic shows a significant EU-facing reorientation for the steel HS6 lines that dominate Vietnam's post-period EU dirty basket. For flat-rolled steel products, the EU share rises sharply from very low pre-period levels to account for around half (or more) of total exports in the post-period. HS 720838 increases from 2.5% to 59.1%, HS 721049 from 7.2% to 46.8% and HS

720839 from 0.8% to 38.8%. This shift is significant: it implies that the post-period increase in EU-facing 'dirty' composition is driven by a clear reorientation of steel exports towards the EU destinations, rather than by growth across all destinations. In terms of interpretation, therefore, Vietnam shows evidence of destination-based sorting, but into steel-heavy CBAM categories instead of 'green' products. For cement-related HS6 lines that are prominent on the RoW side, the EU share also increases, but remains substantially lower than for steel and continues to be dominated by RoW. For example, the EU share of HS 252310 (clinker) rises from 1.3% to 20.3%, while the EU share of HS 252329 (Portland cement) rises from 1.4% to 21.5%. While this suggests an increase in EU orientation for cement and clinker, the main post-period EU-facing 'dirty' story remains the reorientation of steel, as documented above, rather than a broad shift in cement exports into the EU market.

On the green side, the HS6 decomposition shows very strong concentration, and the EU-share diagnostic helps to separate a global expansion channel from EU-facing sorting within particular product lines. For the measurement and monitoring codes that are important in Vietnam’s EU green basket, the EU share rises significantly after the period: HS 903180 increases from 9.7% to 36.9%, while HS 903289 rises from 40.5% to 52.9%. This suggests that part of Vietnam’s post-period green pattern involves EU-facing sorting in 'instrument-type' product lines, which is consistent with the weak Brussels Effect logic discussed in the theory chapter. At the same time, however, Vietnam’s dominant post-period green code (HS 854143) appears to reflect a broader scale-up, with RoW remaining the primary destination even though the EU accounts for a substantial share (around one-third). It is important to note that Vietnam’s 'greening' signal is not purely EU-driven, but instead combines (i) the broad expansion of a highly concentrated green technology line and (ii) destination-specific reorientation towards the EU for selected instrument and monitoring lines.

6.2.1 Vietnam policy timeline and expectations

Vietnam’s post-2020 adjustments are taking place against the backdrop of an existing (albeit uneven) ‘green governance build-up’ rather than a clean slate of policies. During the 2010s, the state progressively formalised a climate/green growth orientation, first through the National Climate Change Strategy (Decision 2139/QĐ-TTg, 5 December 2011), and then through the National Green Growth Strategy (Decision 1393/QĐ-TTg, 25 September 2012) (Prime Minister VNM, 2011; Prime Minister VNM, 2012). At the same time, Vietnam’s transition was constrained by the need for rapid electrification and energy security. The revised Power Development Plan VII (Decision 428/QĐ-TTg, 18 March 2016) exemplifies this duality: while renewables are prioritised in theory, the trajectory of the system remains shaped by the need for large baseload capacity and reliance on fossil fuels[14] (GIZ, 2016).

[14] In principle, official power planning prioritises renewables, but the planned generation mix is projected to remain dominated by coal until 2030 (Revised PDP7; Decision 428/QĐ-TTg). This implies that there are binding energy security and system capacity constraints alongside green ambitions.

Another policy development that plausibly shaped Vietnam's pre-agreement trajectory was the acceleration of renewable energy, made possible by progressive green policies. This is important for the export story because rapid domestic deployment can create domestic demand for equipment and 'instrument-type' inputs (e.g. monitoring, metering, control systems and electrical components), as well as building capability firms, regulators and utilities gain experience with standards, certification, reporting and grid integration requirements. These channels of demand and capability can spill over into external markets, making it more likely that the observed 'green' export growth reflects not only incentives facing the EU, but also a broader domestic transition that is already underway. For instance, Vietnam first approved a Renewable Energy Development Strategy (Decision 2068/QĐ-TTg, 25 November 2015), and subsequently adopted substantial solar incentives (Grantham Research Institute, 2026a). By 31 December 2020, EVN had connected around 101,029 rooftop solar projects with around 9,296 MWp installed. This indicates that substantial clean energy deployment, and the associated monitoring and administrative capacity, was already underway before the EVFTA came into force (EVN Vietnam, 2021).

Against this backdrop, the EU–Vietnam Free Trade Agreement (EVFTA) came into effect on 1 August 2020. This created a significant change in the predictability of market access and deepened channels for the diffusion of standards through buyer requirements, contracting and institutional cooperation (European Commission, 2025d).

In 2021, Vietnam bolstered long-term expectations of green restructuring by approving the National Green Growth Strategy 2021–2030 (Vision 2050; Decision 1658/QĐ-TTg, 1 October 2021)(Government News VNM, 2021). At the same time, Vietnam's political signalling at COP26, including the Prime Minister's high-level remarks, anchored the net-zero ambition and reinforced the idea that climate policy would tighten rather than be reversed (Phạm, 2021). From 2022 onwards, Vietnam's environmental policy framework became more administratively enforceable with the introduction of the 2020 Law on Environmental Protection and the publication of specific implementation regulations.

The Law took effect on 1 January 2022, and key implementing legislation, especially Decree 08/2022/ND-CP, expanded the practical scope of permitting, monitoring and producer responsibilities (including the institutional basis for Extended Producer Responsibility (EPR)) (Grantham Research Institute , 2026b). Meanwhile, Decree 06/2022/ND-CP established a framework linked to Measurement, Reporting and Verification (MRV) for Greenhouse Gas (GHG) mitigation and the development of a domestic carbon market (KPMG, 2022). In parallel, the transition's enabling conditions are increasingly incorporated into power-sector planning and international transition finance. For example, Vietnam's Just Energy Transition Partnership (political declaration, 14 December 2022) and the JETP Resource Mobilisation Plan (published December 2023) set out an investment and reform agenda for the electricity transition (BMZ, 2025).

Finally, within the sample window, the EU's carbon-constraint channel becomes salient via compliance anticipation rather than full pricing. The Carbon Border Adjustment Mechanism entered its transitional (reporting) phase on 1 October 2023, with the financially material phase scheduled to begin in 2026. This timing is consistent with the idea that the effects observed in the EU in 2023–2024 are primarily due to documentation and buyer screening rather than a fully priced border charge (European Commission, 2026a).

After the EVFTA, Vietnam shows a mixed adjustment pattern: while EU-facing 'green' exports rise strongly, 'dirty' (CBAM-scope) exports also increase. This is consistent with Vietnam's dual-track baseline of a stated green transition alongside ongoing industrial expansion.

Plausible drivers of the green rise are: (i) market access and predictability under the EVFTA, which shifts EU buyers towards Vietnamese suppliers in compliance-heavy manufactured categories and is reflected in EU-specific sorting (a higher EU share within key HS6 codes); (ii) Vietnam's broader green growth and energy transition trajectory (pre-2020 renewables expansion and post-2021/22 tightening), which can increase green capacity across the economy (EU and RoW); and (iii) increasing EU demand for environmental goods and compliance documentation, reinforced by the EU's climate policy environment.

Plausible drivers of the 'dirty' rise are: (i) industrial expansion and comparative advantage in materials- and energy-intensive production, which scales with improved EU market access; (ii) within this timeframe, CBAM is primarily a reporting and anticipation regime (from late 2023 onwards), so the incentives may not yet be strong enough to reduce volumes; and (iii) compositional dynamics, whereby growth in a few upstream HS6 codes can increase the 'dirty' basket even if the broader policy direction is leaning towards decarbonisation.

Vietnam can be seen as a case where the EVFTA is likely to trigger a reallocation towards the EU on the green margin, while simultaneously enabling short-term scale effects in upstream CBAM sectors. Stricter carbon constraints are expected to become more significant beyond the transitional period.

7. Discussion

Chapter 7 shifts focus from documenting patterns to interpreting their implications for EU green trade governance. Using the EU–Rest of World benchmarking logic employed throughout, the discussion evaluates the descriptive evidence against the thesis hypotheses. These are: whether EU-bound baskets become greener/less dirty after implementation (H1); whether any change is EU-specific, as reflected in EU–RoW composition gaps (H2); whether the depth of agreement plausibly conditions the strength of adjustment (H3); and whether the observed patterns reflect short-run sorting versus longer-run compositional change (H4). Section 7.1 summarises the main contrasts across cases (with Costa Rica and Vietnam as the in-depth cases and Ghana and Ukraine as scope-condition comparisons). Sections 7.2 and 7.3 then interpret these patterns through the lens of destination-based adjustment, where EU–RoW gaps operationalise a 'weak' Brussels effect, and discuss the implications for concerns about carbon leakage and the limits imposed by design, implementation credibility, shocks and time horizons.

7.1 Synthesis of findings

The patterns documented in Chapters 4, 5 and 6 suggest that European Union preferential trade agreements function less as automatic 'greening devices' and more as enabling frameworks, the effects of which depend on the scope of the conditions. The EU–Rest of World benchmarking established in Chapter 4 shows that all four cases exhibit destination-specific composition differences at baseline (see Table 4.1). This implies that post-entry movements should be interpreted in the context of pre-existing sorting rather than against a 'clean slate'.

In this context, the key empirical question is not whether exporters trade more with the EU following an agreement, but rather whether EU-facing compositional change reflects:

(i) destination-based reallocation consistent with a weak Brussels Effect;

(ii) broader upgrading across all destinations; or

(iii) expansion in upstream, emissions-intensive activity that can dominate the composition even under 'green' policy rhetoric.

Costa Rica demonstrates a mechanism of enabling framework under structurally constrained exposure. At baseline, Costa Rica’s basket of goods bound for the EU is already exceptionally 'clean' in terms of the CBAM-proxied 'dirty' margin, with an extremely low EU 'dirty' share and a strongly negative 'dirty' gap (see Table 4.1). This is paired with negligible importance of the EU market within Costa Rica’s dirty sectors: only around 0.4% of Costa Rica’s dirty exports are destined for the EU at baseline (Table 4.2). These scope conditions imply a mechanical limitation: even if EU governance expectations are salient, the 'EU channel' operates on a very small proportion of Costa Rica's dirty-sector activity. This makes large-scale 'cleaning' of the dirty basket unlikely to be detectable in compositional data.

The evidence becomes more informative on the green margin and at the product level, where a detailed analysis reveals patterns consistent with destination-based sorting. Following the agreement, Costa Rica's green basket is dominated by HS84/HS90-type machinery and analytical/precision instruments, and the EU's share of the key HS6 driver codes rises sharply from single-digit levels to around 54–61% (i.e. the fraction of that HS6 product’s total exports that goes to the EU), indicating a shift in focus towards EU demand rather than parallel growth across destinations.

This provides the clearest evidence to support the 'weak Brussels effect' hypothesised in Chapter 2. The sharp increase in the EU’s share of specific green HS lines indicates that firms are segmenting markets effectively, allocating compliance-intensive goods to the EU rather than simply expanding production globally. This aligns with Bradford's (2015) logic that, when the cost of universal compliance is high, regulatory stringency drives destination-specific sorting. EU market access and compliance-related buyer requirements appear to influence the shipping of certain green-classified products, while Costa Rica’s long-standing environmental institutions and staged domestic decarbonisation strategy plausibly shape the capabilities that make such exports feasible.

Importantly, the timing is consistent with a lagged expectations mechanism rather than an immediate 'agreement shock': the thesis emphasises that transport and decarbonisation policy steps taken after 2018/2019 provide a more plausible window for accelerated adjustment signals than the year the agreement came into force.

Vietnam presents a configuration characterised by greater tension, in which the enabling framework interacts with industrial expansion and policy sequencing. While Vietnam enters the agreement with a cleaner EU-bound basket than RoW on the dirty margin (see Table 4.1), unlike Costa Rica, the EU is already a materially relevant market for CBAM-proxied sectors at baseline (approximately 9.6% of dirty exports go to the EU; see Table 4.2). This creates real economic 'room' for post-entry changes in EU-facing dirty composition. At the same time, well before the EU-Vietnam Free Trade Agreement, Vietnam's policy setting was characterised by an explicit duality: climate/green growth orientation was formalised via the National Climate Change Strategy (2011) and National Green Growth Strategy (2012), yet energy security and rapid electrification priorities remained binding. This is exemplified by the revised Power Development Plan VII (2016), which prioritised renewables in principle while keeping the system reliant on large baseload fossil capacity. Against this backdrop, the EVFTA, which came into force on 1 August 2020, increased the predictability of access to the EU market and strengthened channels for the diffusion of standards through buyer requirements and cooperation. However, the domestic tightening measures expected to curb 'dirty' expansion were introduced later: the 2020 Law on Environmental Protection came into effect in 2022 and was implemented through associated regulations. Meanwhile, Vietnam's COP26 net-zero commitment (2050) and subsequent policy and finance initiatives (including the Just Energy Transition Partnership in 2022) only strengthened long-term expectations once the agreement was operational. Within the sample period, the EU's carbon-constraint channel primarily arrives as compliance anticipation rather than a full price signal because the CBAM enters a transitional reporting phase in late 2023, with financial liability scheduled for a later date.

This sequencing helps to explain how Vietnam can demonstrate a shift towards the EU in environmentally friendly sectors while also increasing its exports of steel products within the scope of the CBAM. The HS6 EU-share diagnostic reveals that several steel categories that dominated Vietnam's 'dirty' EU basket post-period have shifted from negligible EU orientation to majority EU destinations (e.g. HS 720838[15] has increased from 2.5% to 59.1%[16]). This indicates a significant reallocation of destinations into steel-heavy CBAM categories, which is

[15] Flat-rolled products of iron or non-alloy steel, of a width of 600 mm or more, hot-rolled, not clad, plated or coated of a thickness of 3 mm or more but less than 4.75 mm

[16] '59%' refers to where HS 720838 is sold. About 59% of Vietnam's exports of this HS6 line go to the EU. This is not the proportion of HS 720838 within Vietnam's 'dirty' basket for the EU.

consistent with the idea that the liberalisation of market access can increase materials- and energy-intensive exports more quickly than environmental constraints tighten. Consequently, the primary concern in this context is not simply 'dirty diversion away from the EU', but rather the possibility of simultaneous greening and browning. According to Grossman and Krueger's (1991) framework, an increased share of green exports (i.e. a composition effect) can coincide with greater overall environmental pressure if the expansion of emissions-intensive exports resulting from trade liberalisation occurs faster than cleaner production techniques are adopted (i.e. through regulation or technology that reduces emissions per unit).

This aligns with Copeland and Taylor's (2004) warning that, in the absence of binding environmental costs, liberalisation may increase pollution-intensive trade faster than it induces broader upgrading.

On the green side, the same analysis shows an EU-facing reorientation of product lines classified as instruments (e.g. measurement and monitoring categories), which is consistent with the idea of a weak Brussels Effect operating where EU compliance demand is salient and suppliers can meet documentation and standards requirements. In short, while Vietnam does not demonstrate an absence of the Brussels Effect, it does show that sorting can occur in both directions when industrial expansion is rapid and carbon constraints are not yet economically binding.

Therefore, comparing the two deep dives clarifies why 'agreement depth' and 'greenness on paper' are insufficient conditions. Although Vietnam's EVFTA is characterised as provision-dense in terms of sustainability metrics (TREND-based counts) in the thesis, the outcome is mixed due to domestic energy and industrial constraints, as well as the sequencing of enforceable regulations, which affect what exporters can profitably scale up in the short term. By contrast, Costa Rica is a case where the EU agreement plausibly accelerates destination-specific adjustment in narrow green segments, because (i) the dirty margin is small and weakly exposed to the EU market, and (ii) the domestic decarbonisation strategy provides credible long-term direction, reducing the cost of complying with EU-facing demand, albeit with a lag.

Ghana and Ukraine are boundary-condition cases that restrict the inference of mechanisms from compositional indicators. In Ghana, the baseline EU–RoW differentiation is small (see Table 4.1), and the HS6 basket check reveals an extreme level of concentration. Ghana's EU-bound 'dirty basket' consists almost entirely of aluminium (HS 760110 and HS 760120 account for around 97.6% of exports in the pre-period). Under these conditions, changes in the 'dirty gap' are more likely to reflect volatility in a small set of commodity-linked shipments than a sustained EU-facing greening process mediated by regulatory diffusion.

In turn, Ukraine is structurally high-dirty at baseline and remains anchored in basic metals and upstream inputs. This means that compositional shifts are sensitive to large destination reallocations and disruptions in heavy industry, rather than marginal adjustments in small product lines. Furthermore, the post-period coincides with significant wartime disruption, making it challenging to interpret EU–RoW convergence as 'greening' rather than the result of limited production, logistics and rerouting.

Overall, Section 7.1 supports a disciplined interpretation. EU PTAs act as accelerators and channels for export adjustment, but not as independent drivers of 'greening' the EU's trade. Where domestic policy sequencing and capabilities reduce the cost of meeting EU demand, the agreements are consistent with destination-based sorting into green-classified segments (e.g. Costa Rica and parts of Vietnam). However, where industrial expansion in CBAM-proxied sectors is driven by market access before carbon constraints become financially binding, compositional change can run in the opposite direction (as seen in Vietnam's steel-heavy reorientation).

7.2 Greening vs diversion: what the mixed patterns imply for carbon leakage

A key question in the governance of climate-related trade is whether the apparent 'greening' of export composition to the EU reflects a broader decarbonisation in partner economies or merely a reallocation of products to different markets that leaves emissions-intensive output intact. Such reallocation is consistent with carbon leakage via diversion in the trade-environment literature: exporters can supply a cleaner mix to the EU while redirecting more emissions-intensive products to non-EU destinations. This tension lies at the heart of the thesis's 'weak' (destination-based) Brussels Effect logic, which considers whether the EU receives a systematically different basket of goods than the rest of the world (RoW) and how this difference evolves upon the entry into force of an agreement.

The reason this matters for interpretation is straightforward. If destination-based regulatory pressure were the dominant force, one would expect a sharper divergence in the period after entry, with EU-bound exports becoming cleaner relative to those bound for the Rest of the World (RoW) (i.e. the 'dirty' gap would become more negative), which would be consistent with EU-specific adjustment and potential diversion risk. Conversely, if both EU- and RoW-bound exports become dirtier, or if the EU-bound basket becomes dirtier relative to the RoW basket, then the 'weak Brussels effect' is being overpowered by other forces, such as industrial-scale expansion and market access effects that raise exports across the board.

In practice, this distinction is reflected in the EU–RoW composition gap (Eqs. 5-6). A negative dirty gap indicates that exports to the EU are cleaner than exports to RoW, and a positive dirty gap indicates the opposite. When viewed through the lens of leakage, the 'cleanest' signature of governance-driven decarbonisation would be a reduction in the overall dirty footprint rather than a mere reshuffling of destinations. The strongest diversion signature would be the EU becoming relatively cleaner while dirty exports remain stable or increase in RoW markets, i.e. increasing market segmentation rather than global adjustment.

Across the four cases, the post-period evidence does not primarily resemble the canonical diversion pattern ('EU gets cleaner, RoW gets dirtier'). Instead, the 'dirty gap' increases in all cases. In Vietnam and Ghana, it even reverses into positive territory, implying that exports bound for the EU become dirtier on average than those bound for the Rest of the World (RoW) in the post-period.

This reorients the leakage discussion, as rather than there being a consistent story of dirty exports being displaced away from the EU, the more salient risk in this sample window is that of simultaneous greening and browning. This is where 'green' export growth coexists with expansion in emissions-intensive sectors.

Timing is a crucial scope condition. The post-agreement years observed during this period overlap with what can be described as an anticipation gap in EU climate trade governance, whereby tariff liberalisation and improvements to market access can take effect before carbon constraints become financially binding at the border. The Carbon Border Adjustment Mechanism entered a transitional phase on 1 October 2023, during which time importers must report embedded emissions. The definitive phase is scheduled to begin in 2026.

During this period, there may be incentives to increase exports to the EU from CBAM-scope sectors before carbon costs are fully priced, implying that short-term post-agreement patterns may reflect regulatory lag as much as regulatory diffusion.

Costa Rica is the clearest case in which 'greening' raises comparatively limited leakage concerns. Costa Rica’s exposure to dirty exports destined for the EU is structurally minimal at baseline, in terms of both composition (an unusually clean basket of exports bound for the EU relative to those bound for other regions) and the importance of the EU as a destination for dirty exports. Against this background, a more informative signal comes from the green margin: the green gap increases over time and only turns positive after a delay, which is consistent with gradual, destination-specific adjustment rather than an immediate break at entry. This aligns with the interpretation that upgrading for the EU market is most plausible in compliance-intensive 'green' niches, while the CBAM-base is too small to generate a meaningful leakage dynamic based on diversion in aggregate.

By contrast, Vietnam illustrates how trade liberalisation can increase carbon exposure in the short term rather than reducing it. The country exhibits a sharp reversal in the 'dirty gap' after the agreement comes into effect, shifting from a relatively stable negative pattern before the agreement to a significantly positive gap afterwards. This implies that the basket of goods bound for the EU becomes dirtier relative to the Rest of the World. Meanwhile, Vietnam's green gap remains negative and worsens in the post-period, suggesting that any growth in EU-bound environmental goods occurs against a RoW benchmark where green shares are consistently higher and can increase at least as quickly. From a leakage perspective, this can be interpreted as regulatory lag (or a short-term 'carbon haven' window): market access increases trade, including in CBAM-scope sectors, while the EU's hard carbon constraint has not yet been priced in (European Union, 2023). This implies not only diversion, but also scale expansion: green capacity can grow without crowding out dirty growth when industrial export expansion outpaces decarbonisation constraints.

The results for Ghana and Ukraine further highlight the need for caution when making leakage inferences in compositional data. Ghana’s results are consistent with limited EU-specific greening: green gaps fluctuate around zero, the green signal is weak and the post-period pattern does not exhibit the 'EU gets cleaner while RoW gets dirtier' configuration. Additionally, Ghana’s baseline EU exposure to dirty exports is high, meaning any expansion of upstream CBAM-scope exports would have an immediate impact on EU carbon exposure.

Meanwhile, Ukraine is characterised by substantial volatility and overlapping shocks; therefore, the thesis treats shifts in gaps as descriptive changes shaped by disruption and reorientation, rather than as clean evidence of treaty-driven adjustment.

Furthermore, the cases suggest that the carbon leakage concern, as outlined in the theory chapter — EU-facing greening coupled with the diversion of dirty output — is, in principle, plausible. However, it is not the dominant signature in this sample window. Instead, the results point to a different configuration that is relevant for policy: simultaneous greening and browning, driven by market access and scale effects, operating in parallel with niche, destination-specific greening. This interpretation shifts the emphasis of EU green trade governance from preventing simple diversion to addressing policy sequencing and credibility, particularly the risk that the expansion of trade in the scope of the CBAM induced by liberalisation can outpace the timing at which carbon constraints become materially binding.

7.3 Limits of agreement design and time horizons

Not only is the mixed evidence across cases substantive, it also illustrates the structural limits of what preferential trade agreements can realistically achieve and what compositional trade indicators can credibly reveal within a short observation period. Agreements differ in terms of their depth on paper and in how their commitments translate into incentives over time, how quickly their procedures become operational and how strongly external shocks disrupt the mapping between the timing of the agreement and the observed trade patterns.

Firstly, the design and 'depth' of agreements are imperfect proxies for economic constraints. Although TREND-based environmental provision counts capture the breadth of governance language and institutional mechanisms, they do not directly measure enforceability or the cost of non-compliance (Morin, Dür and Lechner, 2018). Therefore, even provision-dense agreements can operate primarily through cooperation and expectation-setting rather than through immediate, binding decarbonisation constraints. In such settings, tariff-based market access incentives may dominate short-term adjustment, even when environmental norms are prominent in the text. This mirrors the findings of Berger et al. (2020), who suggest that, for developing economies with limited capacity, environmental provisions can act as 'compliance costs', thereby constraining participation in green supply chains rather than automatically inducing upgrades.

Secondly, the timing and credibility of implementation complicate the interpretation of before-and-after results. Market access and procedural operability can be staged, meaning that a single 'treatment year' is an imperfect summary of when incentives become binding. This is particularly relevant for destination-based sorting: firms respond to EU-facing opportunities when market participation is perceived as stable and administratively feasible, so compositional divergence may emerge with a delay. As Handley and Limão (2015) argue, agreements generate value by reducing policy uncertainty. However, the 'option value of waiting' suggests that firms may delay significant reallocation until credibility is fully established. This corroborates the findings of Alessandria et al. (2021), who demonstrate that firms rarely adjust immediately to trade policy, instead following a gradual transition path as they overcome sunk costs and accumulate the necessary capabilities.

Thirdly, sequencing asymmetry arises when carbon constraints are introduced later than trade liberalisation. Within the sample window, the EU's carbon-constraint channel via CBAM first becomes salient through reporting and anticipation rather than full pricing. This creates a period during which tariff barriers fall years before carbon liabilities take full effect. This suggests that post-agreement increases in exports proxied by CBAM, such as the EU-facing 'dirty rise' observed in Vietnam, do not necessarily contradict long-term green policies. Instead, they may reflect rational short-term responses to expanded market access under regulatory lag.

Fourthly, external shocks and policy overlays can dominate compositional change. Ukraine is an example of this: although deep integration provides a strong theoretical basis for standards-related sorting, the wartime regime that has been in place since 2022 has reshaped production and logistics, and emergency market-access measures have further altered effective trade conditions (Rogoff, 2022). In such contexts, movements in the EU–RoW gap plausibly reflect feasibility constraints and rerouting as much as gradual, expectations-driven adjustment.

Finally, the results reinforce the thesis's time-horizon logic. Destination-based adjustment can occur relatively quickly through reallocation, whereas deeper compositional upgrading is slower because it depends on investment cycles and capability formation. This helps to explain why EU-facing signals are clearer in agile green manufacturing niches, but more difficult to detect in capital-intensive upstream sectors. Overall, the design of trade agreements shapes incentives, but it is time, sequencing and shocks that determine whether these incentives result in measurable 'greening' of trade composition.

7.4 Limitations and future research

This thesis takes a descriptive and theory-guided approach, using EU–RoW benchmarking and structured cross-case variation to distinguish EU-specific adjustments from broader global trends. Consequently, the design does not estimate the causal 'treatment effect' of agreements and cannot fully rule out alternative, contemporaneous drivers, such as global demand shifts, commodity cycles, exchange-rate movements or domestic reforms, that may overlap with the post-entry window. Its main contribution lies in transparent pattern identification and scope-condition inference rather than causal attribution.

The empirical results are based on trade composition indicators (shares and EU–RoW gaps), which are derived from UN Comtrade values in US dollars at current exchange rates. Although shares reduce sensitivity to inflation and exchange rates relative to levels, they abstract from quantities, prices and changes in product quality that may be important for environmental improvement. EU-bound trade is measured via mirror imports (EU-reported imports from the partner country) in order to prioritise the accuracy and comparability of the 'EU destination' variable across countries and years. While this improves destination attribution, it introduces a known statistical artefact, the CIF–FOB margin, because mirror imports are typically reported on a CIF basis, whereas exporter-reported totals are typically FOB. This trade-off is accepted because destination splits reported by exporters can be subject to under-reporting or misallocation, and the empirical strategy relies on a clear EU versus non-EU benchmark.

Two cases also involve contextual confounding, which limits inference of mechanisms even within a descriptive framework. This issue is treated here as a scope condition rather than a failure of the data. In Ghana, extreme export concentration and commodity exposure imply that basket shares and gaps may change due to shifts in a small number of sectors rather than sustained improvement. In Ukraine, the wartime regime and emergency trade policy introduced after 2022 reshape logistics, production and effective market access. This means that EU-RoW gap movements may reflect rerouting and feasibility constraints rather than agreement-driven adjustment. The shock period is therefore best treated as analytically distinct.

These limitations highlight several areas for future research. As additional years of data accumulate, particularly once CBAM moves from reporting to financially material compliance, re-estimating the same indicators could reveal whether the observed 'simultaneous greening and browning' patterns persist, or if carbon pricing alters the trajectory of CBAM-scope trade. Future work could also complement HS6 composition with estimates of embedded emissions by combining trade flows with transparent sectoral intensity data or multi-region input–output (MRIO) frameworks. This would move the focus from policy-scope proxies to outcome metrics that are more directly tied to leakage. Finally, a key unresolved issue is whether the same firms are segmenting markets by shipping cleaner products to the EU while increasing CBAM-scope output elsewhere. Addressing this would require firm-level exporter data or customs micro-data, which would enable direct testing of within-firm sorting and provide a clearer link to the logic underlying firm decisions and the Brussels Effect. The optional extension outlined in the thesis — to expand from four case studies to a larger panel of partner countries — could also help to assess whether the scope conditions identified here can be generalised beyond the selected cases.

8. Conclusion

This thesis examined whether EU preferential trade agreements are associated with changes in the composition of exports destined for the EU. The focus was on 'dirty' (CBAM-scope) and 'green' (APEC environmental goods) product baskets, with EU-bound exports being benchmarked against exports to the rest of the world. Across four case studies, the evidence suggests that EU agreements are best understood as enabling frameworks; while they can amplify incentives and expectations for compliance with the EU market, they do not automatically 'green' the trade of partner countries. The appearance of EU-facing greening depends on scope conditions, particularly the baseline export structure, the exposure of the relevant sectors to the EU, and the sequencing of domestic policies and constraints in relation to trade liberalisation.

The contrast between Costa Rica and Vietnam is particularly informative. Costa Rica's approach focuses on the green margin and can be described as destination-based sorting into compliance-intensive niches. This is consistent with a 'weak' Brussels Effect operating where market segmentation is feasible and domestic policy and capabilities support gradual alignment. By contrast, Vietnam illustrates that liberalisation can coincide with simultaneous greening and browning. EU-bound environmental goods can increase alongside expansion in CBAM-proxied industrial sectors, particularly during periods when market access is strengthened before carbon constraints become financially binding. Ghana and Ukraine highlight the limitations of inference: weak governance and commodity concentration (Ghana), and significant shocks accompanied by exceptional policies (Ukraine), can overwhelm or obscure gradual, governance-driven signals in compositional trade indicators.

These results correspond to the working hypotheses as follows: Hypothesis 1 (EU-facing adjustment) receives only partial support. EU-bound green shares rise in the deep-dive cases, but declines in EU-bound dirty shares are inconsistent and can move in the opposite direction when CBAM-scope sectors expand. Hypothesis 2 (the gap-based Brussels effect/ leakage signature) is not consistently supported. EU–RoW gaps do not uniformly widen in the direction of a 'cleaner EU', and in some cases the EU-facing basket becomes more CBAM-intensive relative to the rest of the world (RoW), suggesting that destination-based adjustment does not necessarily result in dirty displacement from the EU market. Hypothesis 3 (agreement depth) is only supported as a scope condition rather than a sufficient cause: provision-dense agreements are compatible with stronger EU-facing sorting on the green margin; however, depth alone does not prevent scale expansion in emissions-intensive sectors. Hypothesis 4 (time horizon) is broadly consistent with the evidence: the clearest EU-facing signals appear as short-term sorting in specific product lines. Deeper upgrading in emissions-intensive sectors, however, plausibly requires longer time horizons and more binding constraints than can be observed within the current timeframe.

In terms of EU policy, the key implication is that decarbonisation in upstream industrial trade is unlikely to be achieved through agreements alone. A more pertinent governance challenge is sequencing: aligning market opening with credible, enforceable climate constraints and the capacity for transition on the part of partners, so that expanded access does not outpace decarbonisation incentives. Once CBAM becomes financially material, future research should reassess these patterns and, where possible, move to firm-level exporter data to test market segmentation directly, establishing whether the same firms supply cleaner EU-facing lines while maintaining or expanding emissions-intensive activity for other destinations.

Ultimately, this thesis suggests that, without visibility of market segmentation at a firm level and without imposing financially binding carbon costs on imports, trade policy can increase industrial exports in the short term. However, decarbonisation outcomes depend on subsequent policy tightening and domestic transition capacity.

9. Bibliography

Abbott, K.W. and Snidal, D. (2000). Hard and Soft Law in International Governance. *International Organization*, 54(3), pp.421–456.

Aichele, R. and Felbermayr, G. (2015). Kyoto and Carbon Leakage: An Empirical Analysis of the Carbon Content of Bilateral Trade. *Review of Economics and Statistics*, 97(1), pp.104–115. doi:https://doi.org/10.1162/rest_a_00438.

Alessandria, G., Choi, H. and Ruhl, K.J. (2021). Trade adjustment dynamics and the welfare gains from trade. *Journal of International Economics*, 131, p.103458. doi:https://doi.org/10.1016/j.jinteco.2021.103458.

APEC (2025). *ANNEX C - APEC List of Environmental Goods | 2012 Leaders' Declaration | APEC*. [online] APEC. Available at: https://www.apec.org/meeting-papers/leaders-declarations/2012/2012_aelm/2012_aelm_annexc? [Accessed 4 Jan. 2026].

Baghdadi, L., Martinez-Zarzoso, I. and Zitouna, H. (2013). Are RTA agreements with environmental provisions reducing emissions? *Journal of International Economics*, 90(2), pp.378–390. doi:https://doi.org/10.1016/j.jinteco.2013.04.001.

Baier, S.L. and Bergstrand, J.H. (2007). Do Free Trade Agreements Actually Increase Members' International Trade? *Journal of International Economics*, 71(1), pp.72–95. doi:https://doi.org/10.2139/ssrn.670982.

Bastiaens, I. and Postnikov, E. (2017). Greening up: the effects of environmental standards in EU and US trade agreements. *Environmental Politics*, 26(5), pp.847–869. doi:https://doi.org/10.1080/09644016.2017.1338213.

Bastos, P. and Silva, J. (2010). The Quality of a Firm's Exports: Where You Export to Matters. *Journal of International Economics*, 82(2), pp.99–111. doi:https://doi.org/10.2139/ssrn.1134827.

Berger, A., Brandi, C., Morin, J.-F. and Schwab, J. (2020). The Trade Effects of Environmental Provisions in Preferential Trade Agreements. *International Trade, Investment, and the Sustainable Development Goals*, pp.111–139. doi:https://doi.org/10.1017/9781108881364.006.

Bernard, A.B., Redding, S.J. and Schott, P.K. (2010). Multi-Product Firms and Product Switching. *American Economic Review*, 100(1). doi:https://doi.org/10.1257/aer.100.1.70.

BMZ (2025). *Just Energy Transition Partnership (JETP) with Viet Nam*. [online] bmz.de. Available at: https://www.bmz.de/resource/blob/246478/factsheet-jetp-vietnam-en.pdf.

Bown, C.P. and Crowley, M.A. (2007). Trade deflection and trade depression. *Journal of International Economics*, 72(1), pp.176–201. doi:https://doi.org/10.1016/j.jinteco.2006.09.005.

Bradford, A. (2015). *The Brussels Effect*. [online] Oxford University Press. Available at: https://scholarlycommons.law.northwestern.edu/nulr/vol107/iss1/1/.

Bradford, A. (2020). *Brussels effect: how the european union rules the world.* [online] New York: Oxford University Press . Available at: https://academic.oup.com/book/36491 [Accessed 2 Jan. 2026].

Brandi, C., Blümer, D. and Morin, J.-F. (2019). When Do International Treaties Matter for Domestic Environmental Legislation? *Global Environmental Politics*, 19(4), pp.14–44. doi:https://doi.org/10.1162/glep_a_00524.

Brandi, C., Schwab, J., Berger, A. and Morin, J.-F. (2020). Do environmental provisions in trade agreements make exports from developing countries greener? *World Development*, [online] 129, p.104899. doi:https://doi.org/10.1016/j.worlddev.2020.104899.

Brunner, S., Flachsland, C. and Marschinski, R. (2012). Credible commitment in carbon policy. *Climate Policy*, 12(2), pp.255–271. doi:https://doi.org/10.1080/14693062.2011.582327.

Bustos, P. (2011). Trade Liberalization, Exports, and Technology Upgrading: Evidence on the Impact of MERCOSUR on Argentinian Firms. *American Economic Review*, 101(1), pp.304–340. doi:https://doi.org/10.1257/aer.101.1.304.

Büthe, T. and Milner, H.V. (2008). The Politics of Foreign Direct Investment into Developing Countries: Increasing FDI through International Trade Agreements? *American Journal of Political Science*, 52(4), pp.741–762. doi:https://doi.org/10.1111/j.1540-5907.2008.00340.x.

Campos, J. (2025). *The Regreening of Costa Rica: A Model for Sustainable Transformation*. [online] SAN. Available at: https://www.sustainableagriculture.eco/post/the-regreening-of-costa-rica-a-model-for-sustainable-transformation.

Copeland, B.R. and Taylor, M.S. (2004). Trade, Growth, and the Environment. *Journal of Economic Literature*, 42(1), pp.7–71. doi:https://doi.org/10.1257/.42.1.7.

Damro, C. (2012). Market power Europe. *Journal of European Public Policy*, [online] 19(5), pp.682–699. Available at: https://www.pure.ed.ac.uk/ws/portalfiles/portal/10091990/DAMRO_2012_Market_power_Europe.pdf.

Das, S., Roberts, M.J. and Tybout, J.R. (2007). Market Entry Costs, Producer Heterogeneity, and Export Dynamics. *Econometrica*, 75(3), pp.837–873. doi:https://doi.org/10.1111/j.1468-0262.2007.00769.x.

Dür, A., Baccini, L. and Elsig, M. (2013). The design of international trade agreements: Introducing a new dataset. *The Review of International Organizations*, 9(3), pp.353–375. doi:https://doi.org/10.1007/s11558-013-9179-8.

EEAS (2021). *The European Union and Ghana | EEAS Website*. [online] www.eeas.europa.eu. Available at: https://www.eeas.europa.eu/ghana/european-union-and-ghana_en?s=101.

EU Council and EU Parliament (2023). *REGULATION (EU) 2023/956 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 10 May 2023 establishing a carbon border adjustment mechanism (Text with EEA relevance)*. [online] Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32023R0956.

European Commission (2013). *EU-Central America Association Agreement | Access2Markets*. [online] trade.ec.europa.eu. Available at: https://trade.ec.europa.eu/access-to-markets/en/content/eu-central-america-association-agreement.

European Commission (2018). *EU-Vietnam Trade Agreement - MEMO*. [online] policy.trade.ec.europa.eu. Available at: https://policy.trade.ec.europa.eu/news/eu-vietnam-trade-agreement-memo-2018-10-17_en.

European Commission (2019). *The European Green Deal*. [online] European Commission. Available at: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en.

European Commission (2021). *Joint statement of the EU and Ghana on the start of trading under the EU-Ghana interim Economic Partnership Agreement - European Commission*. [online] policy.trade.ec.europa.eu. Available at: https://policy.trade.ec.europa.eu/news/joint-statement-eu-and-ghana-start-trading-under-eu-ghana-interim-economic-partnership-agreement-2021-07-01_en.

European Commission (2022). *The power of trade partnerships: together for green and just economic growth*. [online] Available at: https://circabc.europa.eu/ui/group/8a31feb6-d901-421f-a607-ebbdd7d59ca0/library/8c5821b3-2b18-43a1-b791-2df56b673900/details [Accessed 2 Jan. 2026].

European Commission (2023). *Ukraine's path towards EU accession*. [online] European Commission. Available at: https://commission.europa.eu/topics/eu-solidarity-ukraine/ukraines-path-towards-eu-accession_en.

European Commission (2024). *EU trade relations with Ukraine*. [online] policy.trade.ec.europa.eu. Available at: https://policy.trade.ec.europa.eu/eu-trade-relationships-country-and-region/countries-and-regions/ukraine_en.

European Commission (2025a). *Access2Markets EPA - West Africa*. [online] trade.ec.europa.eu. Available at: https://trade.ec.europa.eu/access-to-markets/en/content/epa-west-africa.

European Commission (2025b). *EU trade relations with West Africa*. [online] policy.trade.ec.europa.eu. Available at: https://policy.trade.ec.europa.eu/eu-trade-relationships-country-and-region/countries-and-regions/west-africa_en.

European Commission (2025c). *EU-Ukraine Deep and Comprehensive Free Trade Area | Access2Markets*. [online] Europa.eu. Available at: https://trade.ec.europa.eu/access-to-markets/en/content/eu-ukraine-deep-and-comprehensive-free-trade-area?.

European Commission (2025d). *EU-Viet Nam*. [online] Trade and Economic Security. Available at: https://policy.trade.ec.europa.eu/eu-trade-relationships-country-and-region/countries-and-regions/viet-nam/eu-viet-nam-agreements_en.

European Commission (2026a). *Carbon Border Adjustment Mechanism*. [online] European Commission. Available at: https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en.

European Commission (2026b). *Sustainable development in EU trade agreements*. [online] policy.trade.ec.europa.eu. Available at: https://policy.trade.ec.europa.eu/development-and-sustainability/sustainable-development/sustainable-development-eu-trade-agreements_en [Accessed 4 Feb. 2026].

European Council (2024). *Ukraine: Council backs the renewal of EU's autonomous trade measures*. [online] Consilium. Available at: https://www.consilium.europa.eu/en/press/press-releases/2024/04/08/ukraine-council-backs-the-renewal-of-eu-s-autonomous-trade-measures/.

European Union (2023). *Regulation - 2023/956 - EN - cbam regulation - EUR-Lex*. [online] Europa.eu. Available at: https://eur-lex.europa.eu/eli/reg/2023/956/oj/eng.

EVN Vietnam (2021). *Rooftop Solar Power Boom Is Underway*. [online] EVN Vietnam Electricity. Available at: https://en.evn.com.vn/d6/news/Rooftop-solar-power-boom-is-underway-with-a-total-installed-capacity-reaching-nearly-9300-MWp-66-142-2169.aspx/.

Felbermayr, G. and Peterson, S. (2020). *Economic assessment of Carbon Leakage and Carbon Border Adjustment | Think Tank | European Parliament*. [online] Europa.eu. Available at: https://www.europarl.europa.eu/thinktank/en/document/EXPO_BRI(2020)603501.

Felbermayr, G., Peterson, S. and Wanner, J. (2024). Trade and the environment, trade policies and environmental policies—How do they interact? *Journal of Economic Surveys*, 39(3), pp.1148–1184. doi:https://doi.org/10.1111/joes.12628.

Ghana Statistical Service (2024). *Ghana 2024 Trade Report* . [online] Available at: https://www.statsghana.gov.gh/gssmain/fileUpload/Trade/2024_Trade_Full_Year_Report-_25-02-2025_Final_Print.pdf.

GIZ (2016). *Vietnam Power Development Plan for the period 2011 – 2020*. [online] esp.org.vn. Available at: https://www.esp.org.vn/wp-content/uploads/GIZ_PDP-7-rev_Mar-2016_Highlights_IS.pdf [Accessed 26 Jan. 2026].

Government News VNM (2021). *National Green Growth Strategy for 2021-2030, Vision Towards 2050*. [online] Government News. Available at: https://en.baochinhphu.vn/national-green-growth-strategy-for-2021-2030-vision-towards-2050-11142515.htm.

Government of Costa Rica (2018). *National Decarbonisation Plan* . [online] unfccc.int. Available at: https://unfccc.int/sites/default/files/resource/NationalDecarbonizationPlan.pdf.

Grantham Research Institute (2026a). *Decision No. 2068/QD-TTg on approving Viet Nam's Renewable Energy Development Strategy up to 2030, with an outlook to 2050*. [online] Climate-laws.org. Available at: https://climate-laws.org/document/decision-no-2068-qd-ttg-on-approving-viet-nam-s-renewable-energy-development-strategy-up-to-2030-with-an-outlook-to-2050_de4f [Accessed 26 Jan. 2026].

Grantham Research Institute (2026b). *Decree No. 08/2022/ND-CP dated 10 January 2022 detailing several articles of the Law on Environmental Protection ('Decree 08')*. [online] Climate-laws.org. Available at: https://climate-laws.org/document/decree-no-08-2022-nd-cp-dated-10-january-2022-detailing-several-articles-of-the-law-on-environmental-protection-decree-08_3d6a?q=Vietnam&c=laws [Accessed 26 Jan. 2026].

Grantham Research Institute (2026c). *Law 9518 on incentives and promotion for electric transport*. [online] Climate-laws.org. Available at: https://climate-laws.org/document/law-9518-on-incentives-and-promotion-for-electric-transport_268d [Accessed 21 Jan. 2026].

Grossman, G.M. and Krueger, A.B. (1991). *Environmental impacts of a North American free trade agreement*. Princeton, N.J.: Woodrow Wilson School, Princeton University.

Gulen, H. and Ion, M. (2016). Policy Uncertainty and Corporate Investment. *Review of Financial Studies*, 29(3), pp.523–564.

Guzman, A.T. and Meyer, T.L. (2010). International Soft Law. *Journal of Legal Analysis*, 2(1), pp.171–225. doi:https://doi.org/10.1093/jla/2.1.171.

Handley, K. and Limão, N. (2015). Trade and Investment under Policy Uncertainty: Theory and Firm Evidence. *American Economic Journal: Economic Policy*, 7(4), pp.189–222. doi:https://doi.org/10.1257/pol.20140068.

Hofmann, C., Osnago, A. and Ruta, M. (2018). The Content of Preferential Trade Agreements. *World Trade Review*, 18(3), pp.365–398. doi:https://doi.org/10.1017/s1474745618000071.

Kolcava, D., Nguyen, Q. and Bernauer, T. (2019). Does trade liberalization lead to environmental burden shifting in the global economy? *Ecological Economics*, [online] 163, pp.98–112. doi:https://doi.org/10.1016/j.ecolecon.2019.05.006.

KPMG (2022). *Legal Alert New Regulations on Environmental Protection*. [online] Vietnam, Hanoi: KPMG. Available at: https://assets.kpmg.com/content/dam/kpmg/vn/pdf/Legal-Update/2022/3/Legal-Alert-New-regulations-on-environment-protection-EN.pdf.

Kwakye, G., Kimani, E. and Elmaleh, D. (2024). *8th Ghana Economic Update*. [online] Available at: https://documents1.worldbank.org/curated/en/099073124093539928/pdf/P18123118ad6860d1184d115ab0b4281321.pdf.

Lieberman, E.S. (2005). Nested Analysis as a Mixed-Method Strategy for Comparative Research. *American Political Science Review*, 99(3), pp.435–452. doi:https://doi.org/10.1017/s0003055405051762.

Lileeva, A. and Trefler, D. (2010). Improved Access to Foreign Markets Raises Plant-Level Productivity… for Some Plants*. *Quarterly Journal of Economics*, 125(3), pp.1051–1099. doi:https://doi.org/10.1162/qjec.2010.125.3.1051.

Mansfield, E.D. and Milner, H.V. (2012). *Votes, Vetoes, and the Political Economy of International Trade Agreements*. Princeton University Press.

Martinez-Zarzoso, I. and Oueslati, W. (2016). Are Deep and Comprehensive Regional Trade Agreements Helping to Reduce Air Pollution? *SSRN Electronic Journal*, 292. doi:https://doi.org/10.2139/ssrn.2864281.

Mayer, T., Melitz, M.J. and Ottaviano, G.I.P. (2014). Market Size, Competition, and the Product Mix of Exporters. *American Economic Review*, 104(2), pp.495–536. doi:https://doi.org/10.1257/aer.104.2.495.

Meyer, T. (2016). Shifting Sands: Power, Uncertainty and the Form of International Legal Cooperation. *European Journal of International Law*, 27(1), pp.161–185. doi:https://doi.org/10.1093/ejil/chw005.

Morin, J.-F., Dür, A. and Lechner, L. (2018). Mapping the Trade and Environment Nexus: Insights from a New Data Set. *Global Environmental Politics*, 18(1), pp.122–139. doi:https://doi.org/10.1162/glep_a_00447.

OEC (2023). *Costa Rica (CRI) Exports, Imports, and Trade Partners*. [online] oec.world. Available at: https://oec.world/en/profile/country/cri.

Phạm, C.M. (2021). *Full remarks by PM Pham Minh Chinh at COP26*. [online] Available at: https://primeminister.chinhphu.vn/full-remarks-by-pm-pham-minh-chinh-at-cop26-11240273.htm [Accessed 26 Jan. 2026].

Prime Minister VNM (2012). *Decision No. 1393/QD-TTg of September 25, 2012, approving national strategy on green growth*. [online] THƯ VIỆN PHÁP LUẬT. Available at: https://thuvienphapluat.vn/van-ban/Tai-nguyen-Moi-truong/Decision-No-1393-QD-TTg-approving-national-strategy-on-green-growth-148890.aspx [Accessed 26 Jan. 2026].

Prime Minister VNM (2011). *Approving The National Strategy For Climate Change*. [online] THƯ VIỆN PHÁP LUẬT. Available at: https://thuvienphapluat.vn/van-ban/Tai-nguyen-Moi-truong/Quyet-dinh-2139-QD-TTg-phe-duyet-Chien-luoc-quoc-gia-bien-doi-khi-hau-132631.aspx [Accessed 26 Jan. 2026].

Rogoff, K. (2022). *The Long-lasting Economic Shock of War*. [online] International Monetary Fund. Available at: https://www.imf.org/en/Publications/fandd/issues/2022/03/the-long-lasting-economic-shock-of-war.

Skowron, A., van Riet, R. and Martinez, A. (2020). *Policy Roadmap For 100% RenewableEnergy in Costa Rica*. [online] Available at: https://www.worldfuturecouncil.org/wp-content/uploads/2020/06/wfc_costarica-100-re-roadmap_FINAL1.pdf.

The World Bank (2014). *The WTO Environmental Goods Agreement: Why Even A Small Step Forward Is a Good Step*. [online] World Bank Blogs. Available at: https://blogs.worldbank.org/en/trade/wto-environmental-goods-agreement-why-even-small-step-forward-good-step.

The World Bank (2025). *UKRAINE Fourth Rapid Damage and Needs Assessment (RDNA4)*. [online] Available at: https://documents1.worldbank.org/curated/en/099022025114040022/pdf/P180174-ca39eccd-ea67-4bd8-b537-ff73a675a0a8.pdf.

UN Comtrade (2025). *UN Comtrade*. [online] comtradeplus.un.org. Available at: https://comtradeplus.un.org/.

UN Statistics Division (2025). *About the Data*. [online] Un.org. Available at: https://comtrade.un.org/labs/data-explorer//About.html.

WITS (2023). *Vietnam Trade Summary 2023 | WITS | Text*. [online] Worldbank.org. Available at: https://wits.worldbank.org/CountryProfile/en/Country/VNM/Year/2023/SummaryText.

10. Appendix

Table A.1_topHS6_pre_EU_RoW

basket	country_iso	destination	hs6	value_bn_usd	share_in_basket_pct	category-level
Dirty	CRI	EU	760711	0.00193987693	39.7014254879878	Aluminium and articles thereof
Dirty	CRI	EU	720260	0.001327923901	27.1772250053356	Iron and steel
Dirty	CRI	EU	760720	0.000335438852	6.86507498620243	Aluminium and articles thereof
Dirty	CRI	Rest of World	721041	0.135033961	11.1681480197789	Iron and steel
Dirty	CRI	Rest of World	721420	0.107637336	8.90227681984888	Iron and steel
Dirty	CRI	Rest of World	310590	0.092899033927	7.68332761705182	Fertilizers
Dirty	GHA	EU	760110	0.20765798946	58.843811022318	Aluminium and articles thereof
Dirty	GHA	EU	760120	0.136936342992	38.803497568586	Aluminium and articles thereof
Dirty	GHA	EU	732690	0.003100823219	0.878676789594935	Iron or steel articles
Dirty	GHA	Rest of World	760110	0.124586134828	15.608041034134	Aluminium and articles thereof
Dirty	GHA	Rest of World	310230	0.116030215043	14.5361629533717	Fertilizers
Dirty	GHA	Rest of World	760611	0.113389539377	14.2053414361164	Aluminium and articles thereof
Dirty	UKR	EU	720712	8.572642802113	28.4345404037928	Iron and steel
Dirty	UKR	EU	260112	2.888413826212	9.5805601073283	Ores, slag and ash
Dirty	UKR	EU	720851	2.18668507893	7.25300081462398	Iron and steel
Dirty	UKR	Rest of World	720720	7.929618524152	10.0844641091192	Iron and steel
Dirty	UKR	Rest of World	721420	7.355645225333	9.35451561110471	Iron and steel
Dirty	UKR	Rest of World	720711	7.181286129036	9.13277505153679	Iron and steel

Dirty	VNM	EU	731815	0.882924161956	16.7202126886765	Iron or steel articles
Dirty	VNM	EU	731812	0.667782521848	12.6460077503641	Iron or steel articles
Dirty	VNM	EU	731814	0.530503760802	10.0463166543111	Iron or steel articles
Dirty	VNM	Rest of World	252310	4.670037864013	9.52287250599593	Cement clinkers
Dirty	VNM	Rest of World	721061	2.57635116527	5.25354705720903	Iron and steel
Dirty	VNM	Rest of World	252329	2.207569925917	4.50154957298649	Portland cement
Green	CRI	EU	841199	0.002119990589	25.211093044537	Nuclear reactors, boilers, machinery and mechanical appliances
Green	CRI	EU	842199	0.001968072624	23.4044727837564	Nuclear reactors, boilers, machinery and mechanical appliances
Green	CRI	EU	847990	0.000688155749	8.18360171370178	Nuclear reactors, boilers, machinery and mechanical appliances
Green	CRI	Rest of World	903289	0.02077135028	23.1278922057092	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus
Green	CRI	Rest of World	854390	0.01278012509	14.2300501157886	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers
Green	CRI	Rest of World	847990	0.008856192251	9.86094100639111	Nuclear reactors, boilers, machinery and mechanical appliances
Green	GHA	EU	841182	0.009781556957	26.871605230743	Nuclear reactors, boilers, machinery and mechanical appliances
Green	GHA	EU	901580	0.007133735015	19.5975867631815	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus
Green	GHA	EU	841199	0.005431298903	14.9207044086309	Nuclear reactors, boilers, machinery and mechanical appliances

Green	GHA	Rest of World	841182	0.039618945664	26.3698301483248	Nuclear reactors, boilers, machinery and mechanical appliances
Green	GHA	Rest of World	847989	0.034440672531	22.9232421412411	Nuclear reactors, boilers, machinery and mechanical appliances
Green	GHA	Rest of World	841780	0.017897619166	11.91241133647	Nuclear reactors, boilers, machinery and mechanical appliances
Green	UKR	EU	841199	0.055054134153	17.0575913777335	Nuclear reactors, boilers, machinery and mechanical appliances
Green	UKR	EU	841290	0.041559805859	12.8766022204734	Nuclear reactors, boilers, machinery and mechanical appliances
Green	UKR	EU	847982	0.039838585158	12.3433111272566	Nuclear reactors, boilers, machinery and mechanical appliances
Green	UKR	Rest of World	841182	1.159676389437	28.2945645005063	Nuclear reactors, boilers, machinery and mechanical appliances
Green	UKR	Rest of World	840690	0.327500462812	7.99057655513578	Nuclear reactors, boilers, machinery and mechanical appliances
Green	UKR	Rest of World	903289	0.298266230733	7.27730009912066	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus
Green	VNM	EU	901380	0.286181205564	44.8283014309412	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus
Green	VNM	EU	903180	0.04267921037	6.68540236082361	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus
Green	VNM	EU	847989	0.039195567583	6.13971387430825	Nuclear reactors, boilers, machinery and mechanical appliances
Green	VNM	Rest of World	901380	7.766189352062	48.5747462744655	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus

Green	VNM	Rest of World	850490	2.774827226508	17.3555552630606	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers
Green	VNM	Rest of World	840290	0.716722063252	4.4828410425679	Nuclear reactors, boilers, machinery and mechanical appliances

Table Notes: Table A.1 shows the main HS6 product codes in the thesis's 'dirty' (CBAM scope) and 'green' (APEC environmental goods) baskets during the pre-agreement period, divided into EU-bound exports and exports to the Rest of the World (RoW). For each basket-country-destination cell, the table lists the HS6 codes, ranked by trade value (billions of US dollars) and their share of the basket (%), alongside a broad, category-level label to aid interpretation. The table documents baseline concentration and clarifies which product lines 'drive' each basket before implementation. Trade values are from UN Comtrade (HS6).

Table A.2 Top HS6 post EU_RoW

basket	country_iso	destination	hs6	value_bn_usd	share_in_basket_pct	category-level
Dirty	CRI	EU	732620	0.028647580674	41.826990348928	Iron or steel articles
Dirty	CRI	EU	732690	0.01095975717	16.0018279586252	Iron or steel articles
Dirty	CRI	EU	730441	0.007283265609	10.633954880972	Iron or steel articles
Dirty	CRI	Rest of World	721420	0.730899872681	18.8983690349847	Iron and steel
Dirty	CRI	Rest of World	732690	0.241171207778	6.23579597638107	Iron or steel articles
Dirty	CRI	Rest of World	730661	0.221268041433	5.72117366406243	Iron or steel articles
Dirty	GHA	EU	760110	0.684120758951	95.5255671053036	Aluminium and articles thereof
Dirty	GHA	EU	760120	0.024052584728	3.35852518203608	Aluminium and articles thereof
Dirty	GHA	EU	732690	0.001587806448	0.221709558457532	Iron or steel articles
Dirty	GHA	Rest of World	721420	0.466277062358	30.2032081962652	Iron and steel

Dirty	GHA	Rest of World	310230	0.132169492612	8.56131048430177	Fertilizers
Dirty	GHA	Rest of World	730661	0.103408776163	6.69832819992779	Iron or steel articles
Dirty	UKR	EU	720712	7.108690243501	18.7491349543052	Iron and steel
Dirty	UKR	EU	260112	6.569370224338	17.3266811018406	Ores, slag and ash
Dirty	UKR	EU	720711	2.815492050305	7.42584619750489	Iron and steel
Dirty	UKR	Rest of World	260112	7.206451371752	15.0245615307278	Ores, slag and ash
Dirty	UKR	Rest of World	720110	5.363008192606	11.1812100606761	Iron and steel
Dirty	UKR	Rest of World	720711	5.262758525181	10.9722018791228	Iron and steel
Dirty	VNM	EU	721049	2.919954348731	22.7915334863377	Iron and steel
Dirty	VNM	EU	720839	0.892009188545	6.96252573252721	Iron and steel
Dirty	VNM	EU	720838	0.881574699899	6.88107993955052	Iron and steel
Dirty	VNM	Rest of World	721049	3.654703358493	7.25602055700023	Iron and steel
Dirty	VNM	Rest of World	252310	2.781653796233	5.52267452323328	Cement clinkers
Dirty	VNM	Rest of World	252329	2.605871958396	5.17367858463582	Portland cement
Green	CRI	EU	847989	0.022134642583	26.315679038343	Nuclear reactors, boilers, machinery and mechanical appliances
Green	CRI	EU	902730	0.021191365141	25.194224905316	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus

Green	CRI	EU	902710	0.015787361329	18.7694529983237	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus
Green	CRI	Rest of World	903289	0.082112385737	30.51867883237	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus
Green	CRI	Rest of World	903190	0.027415802894	10.1896209194727	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus
Green	CRI	Rest of World	854390	0.020548308472	7.63718190839095	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers
Green	GHA	EU	901580	0.004714806727	26.6117335093306	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus
Green	GHA	EU	841199	0.002894359489	16.3366025080905	Nuclear reactors, boilers, machinery and mechanical appliances

Gree n	GHA	EU	903289	0.00125556 8981	7.0867946576919 6	Optical, photographic, cinematographic , measuring, checking, medical or surgical instruments and apparatus
Gree n	GHA	Rest of World	841199	0.00368381 2356	14.957544332146 5	Nuclear reactors, boilers, machinery and mechanical appliances
Gree n	GHA	Rest of World	847989	0.00281257 017	11.420001601473 5	Nuclear reactors, boilers, machinery and mechanical appliances
Gree n	GHA	Rest of World	841990	0.00258413 4339	10.492473611708 2	Nuclear reactors, boilers, machinery and mechanical appliances
Gree n	UKR	EU	841199	0.15964119 7698	19.193784474624 2	Nuclear reactors, boilers, machinery and mechanical appliances
Gree n	UKR	EU	847982	0.10087072 0867	12.127764662501 2	Nuclear reactors, boilers, machinery and mechanical appliances
Gree n	UKR	EU	847990	0.10047297 5693	12.079943453091 2	Nuclear reactors, boilers, machinery and mechanical appliances
Gree n	UKR	Rest of World	841182	0.44148782 254	21.673391119113 4	Nuclear reactors, boilers, machinery and mechanical appliances
Gree n	UKR	Rest of World	847420	0.23979494 2034	11.771943192424 4	Nuclear reactors, boilers, machinery and mechanical appliances

Green	UKR	Rest of World	841990	0.163284641061	8.01592186416073	Nuclear reactors, boilers, machinery and mechanical appliances
Green	VNM	EU	854143	0.278994233554	24.4275689156597	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers
Green	VNM	EU	903180	0.202042964372	17.6900374364402	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus
Green	VNM	EU	903289	0.079513493183	6.96186910284878	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus
Green	VNM	Rest of World	854143	13.977065077821	65.9209521179573	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers
Green	VNM	Rest of World	850490	1.450424470265	6.84073240860653	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers

Green	VNM	Rest of World	854142	0.81882572096	3.8618816499616	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers

Table Notes: Table A.2 is similar to Table A.1, but shows data for the post-agreement period. It lists the top HS6 product codes in the 'dirty' and 'green' baskets by destination (EU vs. RoW). It shows the trade value (in billions of US dollars) and the percentage share of the largest product lines within the basket, enabling direct comparison to be made as to whether post-period changes reflect broad-based shifts or are driven by a small number of HS6 categories. Trade values are from UN Comtrade (HS6).

Table A.3 Costa Rica & Vietnam pre/post HS6

basket	country_iso	pre/post	destination	hs6	value_bn_usd	share_in_basket_pct	category-level
Dirty	CRI	pre	EU	760711	0.00193987693	39.7014254879878	Aluminium and articles thereof
Dirty	CRI	pre	EU	720260	0.001327923901	27.1772250053356	Iron and steel
Dirty	CRI	pre	EU	760720	0.000335438852	6.86507498620243	Aluminium and articles thereof
Dirty	CRI	pre	Rest of World	721041	0.135033961	11.1681480197789	Iron and steel
Dirty	CRI	pre	Rest of World	721420	0.107637336	8.90227681984888	Iron and steel
Dirty	CRI	pre	Rest of World	310590	0.092899033927	7.68332761705182	Fertilizers
Dirty	CRI	post	EU	732620	0.028647580674	41.826990348928	Iron or steel articles
Dirty	CRI	post	EU	732690	0.01095975717	16.0018279586252	Iron or steel articles
Dirty	CRI	post	EU	730441	0.007283265609	10.633954880972	Iron or steel articles
Dirty	CRI	post	Rest of World	721420	0.730899872681	18.8983690349847	Iron and steel

basket	country_iso	pre/post	destination	hs6	value_bn_usd	share_in_basket_pct	category-level
Dirty	CRI	post	Rest of World	732690	0.241171207778	6.23579597638107	Iron or steel articles
Dirty	CRI	post	Rest of World	730661	0.221268041433	5.72117366406243	Iron or steel articles
Green	CRI	pre	EU	841199	0.002119990589	25.211093044537	Nuclear reactors, boilers, machinery and mechanical appliances
Green	CRI	pre	EU	842199	0.001968072624	23.4044727837564	Nuclear reactors, boilers, machinery and mechanical appliances
Green	CRI	pre	EU	847990	0.000688155749	8.18360171370178	Nuclear reactors, boilers, machinery and mechanical appliances
Green	CRI	pre	Rest of World	903289	0.02077135028	23.1278922057092	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus

basket	country_iso	pre/post	destination	hs6	value_bn_usd	share_in_basket_pct	category-level
Green	CRI	pre	Rest of World	854390	0.01278012509	14.2300501157886	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers
Green	CRI	pre	Rest of World	847990	0.008856192251	9.86094100639111	Nuclear reactors, boilers, machinery and mechanical appliances
Green	CRI	post	EU	847989	0.022134642583	26.315679038343	Nuclear reactors, boilers, machinery and mechanical appliances
Green	CRI	post	EU	902730	0.021191365141	25.194224905316	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus

basket	country_iso	pre/post	destination	hs6	value_bn_usd	share_in_basket_pct	category-level
Green	CRI	post	EU	902710	0.015787361329	18.7694529983237	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus
Green	CRI	post	Rest of World	903289	0.082112385737	30.51867883237	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus
Green	CRI	post	Rest of World	903190	0.027415802894	10.1896209194727	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus
Green	CRI	post	Rest of World	854390	0.020548308472	7.63718190839095	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers

basket	country_iso	pre/post	destination	hs6	value_bn_usd	share_in_basket_pct	category-level
Dirty	VNM	pre	EU	731815	0.882924161956	16.7202126886765	Iron or steel articles
Dirty	VNM	pre	EU	731812	0.667782521848	12.6460077503641	Iron or steel articles
Dirty	VNM	pre	EU	731814	0.530503760802	10.0463166543111	Iron or steel articles
Dirty	VNM	pre	Rest of World	252310	4.670037864013	9.52287250599593	Cement clinkers
Dirty	VNM	pre	Rest of World	721061	2.57635116527	5.25354705720903	Iron and steel
Dirty	VNM	pre	Rest of World	252329	2.207569925917	4.50154957298649	Portland cement
Dirty	VNM	post	EU	721049	2.919954348731	22.7915334863377	Iron and steel
Dirty	VNM	post	EU	720839	0.892009188545	6.96252573252721	Iron and steel
Dirty	VNM	post	EU	720838	0.881574699899	6.88107993955052	Iron and steel
Dirty	VNM	post	Rest of World	721049	3.654703358493	7.25602055700023	Iron and steel
Dirty	VNM	post	Rest of World	252310	2.781653796233	5.52267452323328	Cement clinkers
Dirty	VNM	post	Rest of World	252329	2.605871958396	5.17367858463582	Portland cement
Green	VNM	pre	EU	901380	0.286181205564	44.8283014309412	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus

basket	country_iso	pre/post	destination	hs6	value_bn_usd	share_in_basket_pct	category-level
Green	VNM	pre	EU	903180	0.04267921037	6.68540236082361	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus
Green	VNM	pre	EU	847989	0.039195567583	6.13971387430825	Nuclear reactors, boilers, machinery and mechanical appliances
Green	VNM	pre	Rest of World	901380	7.766189352062	48.5747462744655	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus
Green	VNM	pre	Rest of World	850490	2.774827226508	17.3555552630606	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers

basket	country_iso	pre/post	destination	hs6	value_bn_usd	share_in_basket_pct	category-level
Green	VNM	pre	Rest of World	840290	0.716722063252	4.4828410425679	Nuclear reactors, boilers, machinery and mechanical appliances
Green	VNM	post	EU	854143	0.278994233554	24.4275689156597	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers
Green	VNM	post	EU	903180	0.202042964372	17.6900374364402	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus
Green	VNM	post	EU	903289	0.079513493183	6.96186910284878	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus

basket	country_iso	pre/post	destination	hs6	value_bn_usd	share_in_basket_pct	category-level
Green	VNM	post	Rest of World	854143	13.977065077821	65.9209521179573	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers
Green	VNM	post	Rest of World	850490	1.450424470265	6.84073240860653	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers
Green	VNM	post	Rest of World	854142	0.81882572096	3.8618816499616	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers

Table Notes: Table A.3 provides a focused pre/post HS6 diagnostic for Costa Rica and Vietnam. It lists the leading HS6 codes in the 'dirty' and 'green' baskets by destination (EU vs. RoW) and by period (pre vs. post). This table is used in Chapter 6 to identify the specific product lines that account for the observed changes in aggregate shares and EU–RoW gaps (i.e. whether the changes are concentrated in a few HS6 codes or reflect a broader compositional adjustment). Trade values are from UN Comtrade (HS6).

Declaration of Authorship

I hereby certify that I have written this thesis independently and have not used any sources, resources or technical tools other than those specified. All statements taken from other publications, either literally or in substance, are marked accordingly. I have not submitted this work in the same or a similar form to any other examination authority, except insofar as submission to the partner institution is required within the framework of the double-degree programme.

Trier, 19.02.2026 J. Hecker

Place, Date Signature