UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT

EMBARGO
The contents of this report must not be quoted
or summarized in the print,
broadcast or electronic media before
14 July 2021, 4 p.m. GMT
(6:00 p.m. Geneva)

A European Union Carbon Border Adjustment Mechanism:

Implications for developing countries

UNITED NATIONS
UNCTAD

Abstract

As part of a plan to decarbonize its economy by 2050, the European Union is considering the introduction of a carbon border adjustment mechanism (CBAM), to reduce the risk of carbon leakage and to level the field for European industries working towards decarbonization of their production processes.

Using a general equilibrium model, this study looks at the potential effects of a CBAM on international trade, carbon dioxide (CO_2) emissions, income and employment, with a special focus on developing and vulnerable countries. The study confirms that the introduction of carbon pricing coupled with a CBAM helps reduce CO_2 emissions, inside and outside the European Union. International trade patterns change in favour of countries where production is relatively carbon efficient. However, the reduction represents only a small percentage of global CO_2 emissions. The introduction of a CBAM results in declines in exports in developing countries in favour of developed countries, which tend to have less carbon intensive production processes.

Potentially, the European Union could consider CBAM flanking policies, including the use of revenue generated by the CBAM, to accelerate the diffusion and uptake of cleaner production technologies to developing country producers. This could be beneficial both in terms of greening the economy and fostering a more inclusive trading system.

TABLE OF CONTENT

Acknowledgements

This paper was prepared by a team led by Isabelle Durant, Acting Secretary-General, UNCTAD. The team was composed by Claudia Contreras, Robert Hamwey, Graham Mott, Alessandro Nicita, Ralf Peters, Carlos Razo and David Vivas, from the Division on International Trade and Commodities (DITC) of UNCTAD and Maksym Chepeliev and Erwin Corong from the Center for Global Trade Analysis, Purdue University. This paper also benefited from comments and contributions of Bruno Antunes, Samuel Munyaneza, Jenifer Tacardon and Simonetta Zarrilli from DITC.

The model used in this study has been developed in a joint project by the Center for Global Trade Analysis (Purdue University) and UNCTAD.

Graphic design and desktop publishing were done by Nadege Hadjemian.

Table of Contents

TABLE OF CONTENT

Introduction

As countries continue to battle the COVID-19 pandemic and attempt to recover from the hard economic crisis it has induced, the world continues its efforts to fight another looming threat on our development possibilities and on humanity as a whole: climate change. Indeed, climate and environmental considerations are now at the forefront of policy concerns and have become omnipresent in public policy, and trade is no exception.

Parties to the UNFCCC agreed in 2015 to combat climate change and to accelerate and intensify the actions needed for a sustainable low carbon future. One such action is the reduction of carbon dioxide (CO_2) emissions, one of the main greenhouse gases (GHG) causing global warming. The challenge is not minor. CO_2 emissions have persistently followed an upward trend for decades, which was only briefly interrupted in 2020 due to pandemic-related economic shutdowns. Carbon emissions saw another record high in early 2021.

CO_2 yearly emissions have more than quadrupled since the establishment of General Agreement on Tariffs and Trade (GATT) in 1947. Since the creation of the World Trade Organization in1995, these emissions have increased by 50 per cent. When the institutions that underpin our multilateral trading system were created, the climate and environmental challenges were not the emergencies they are today. Whilst it is not surprising that GATT rules were not drafted in support of climate considerations, there is now an absolute imperative to update and adapt the trade policy toolkit to meet these challenges.

Climate change is a global problem which, if tackled, would truly need an international effort. However, whilst there is strong common interest in tackling climate change, there are large incentives for nations to minimize mitigation efforts and free ride on the efforts of others. In addition, the efforts required to tackle climate change need to be reconciled with climate fairness, e.g, the fact that countries have contributed differently to the accumulation of CO_2 emissions and that those countries most likely to be affected by climate change would be those least responsible for it. Free riding and climate fairness are the two main issues behind the difficulties in reaching meaningful international agreements on reducing emissions.

Trade is one policy area that is increasingly considered as an avenue for limiting the free rider problem. This paper looks at the proposal of the European Union to implement a carbon border adjustment mechanism (CBAM). In short, the CBAM compensates for differences in carbon prices between domestic and imported products.

TABLE OF CONTENT

In 2019, the European Union launched its Green Deal–a plan to decarbonize its economy by 2050.As part of this plan, the European Union is introducing a CBAM to reduce the risk of carbon leakage[1,2] and to level the field for European industries that have been working towards decarbonization of the economy. The stated goal of the CBAM is to avoid the European Union's efforts to reduce GHG emissions being weakened by a lack of climate action of non-European Union countries with less ambitious policies and regulations in this area. Indeed, the emissions embedded in the goods and services imported to the European Union have been rising and currently represent 20 per cent of the European Union's domestic CO_2 emissions (European Parliament, 2021a). The details of the CBAM proposal will be presented by the European Commission in July 2021[3] the mechanism is expected to begin operation in 2023 (European Parliament, 2021b).

Several trade partners of the European Union, particularly developing countries, have already raised concerns on the potential impact of the CBAM on their exports and competitiveness.[4] The CBAM raises discussions as two issues that will be inevitably intertwined: addressing carbon leakage and the effect on firm competitiveness, inside and outside the European Union. Some developing countries, especially Least Developed Countries (LDCs), will need support to incorporate green technologies in their production processes and reduce related CO_2 emissions (IISD, 2021; United Nations, 2021). Further, there have been calls to support a smooth transition to help countries to adapt to the effects of the European Union's climate change mitigation policies.[5]

This report looks at the potential effects of the CBAM on CO_2 emissions, trade, income and employment in the European Union and its main trading partners, particularly developing countries. The study also looks at the potential effects of exempting vulnerable nations, such as LDCs and Small Island Developing States (SIDS) from the CBAM.

The report is structured as follows. Section 2 describes the main characteristics of the CBAM based on available public information, including the sectors considered for its application, and its expected implications for trade and emissions based on recent literature. Section 3 presents a literature review. Section 4 describes the Global Trade Analysis Project (GTAP) computable general equilibrium model used for the assessment, the main assumptions of the modelling exercise, and the different scenarios analysed. Section 5 presents the main findings of the analyses and discusses the key implications for the European Union and its trading partners, with a focus on developing countries. Section 6 concludes and offers alternative policies and approaches to support developing countries in the uptake of cleaner production technologies. This could be beneficial both in terms of greening the economy and fostering a more inclusive trading system.

1 European Parliament resolution of 10 March 2021 "supports the introduction of a CBAM, provided that it is compatible with WTO rules and European Union free trade agreements by not being discriminatory or constituting a disguised restriction on international trade" (European Parliament, 2021a).

2 Carbon leakage refers to the relocation of production to other countries with laxer emissions constraints for costs reasons related to climate policies, which could lead to an increase in their total emissions. See https://ec.europa.eu/clima/policies/ets/allowances/leakage_en (accessed on 9 July 2021).

3 During the presentation of the European Union's "Fit for 55", the legislative package on climate and energy that reflects the European Union's ambitions to reduce carbon emissions.

4 For instance, in a statement from the 30th BASIC (Brazil, South Africa, India and China) Ministerial Meeting on Climate Change held on 8 April 2021, ministers expressed "grave concern regarding the proposal for introducing trade barriers, such as unilateral carbon border adjustment, that are discriminatory and against the principles of Equity and principles of Equity and CBDR-RC [Common but Differentiated Responsibilities and Respective Capabilities]" (South African Government, 2021).

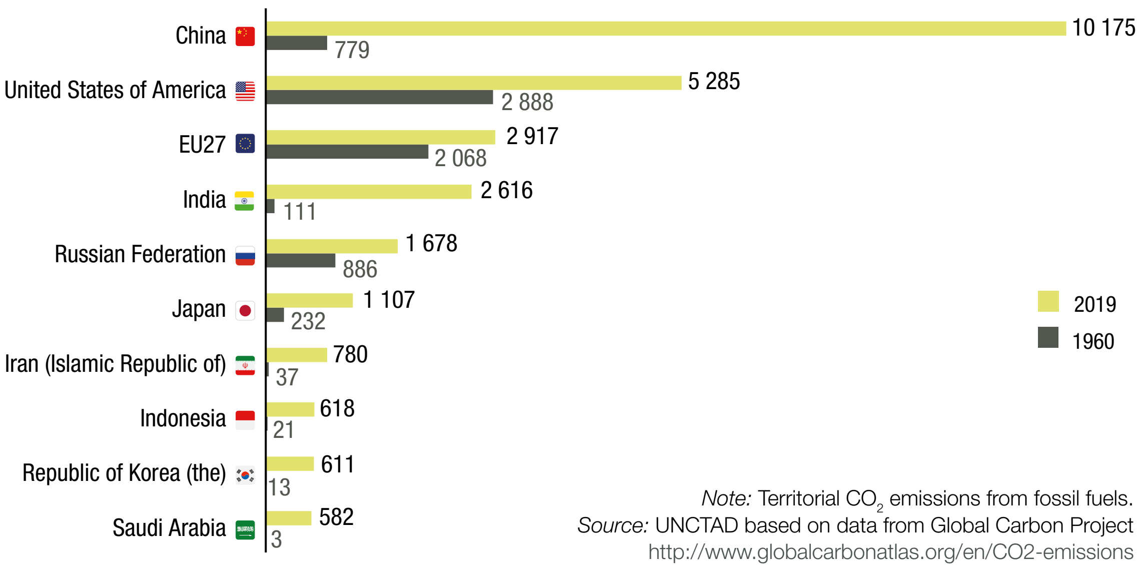
5 See for instance United Nations (2021) on the need for a smooth transition for graduating LDCs.

The European Union Carbon Border Adjustment Mechanism

Main features of the CBAM

On 10 March 2021, the European Parliament adopted a resolution titled: "A WTO-compatible EU carbon border adjustment mechanism".[6] This resolution supports the introduction of a CBAM compatible with WTO rules and European Union's free trade agreements by not being discriminatory or constituting a disguised restriction on international trade (European Parliament, 2021b). The resolution specifically links the CBAM to the European Union Emissions Trading System (ETS). It underlines that the European Union's ambition on climate change should not lead to carbon leakage, as there would be no resulting global benefit of reduced carbon emissions if the production in the European Union is simply moved to countries outside the European Union that have less ambitious emission reduction targets (European Parliament, 2021b). Currently, considering territorial CO_2 emissions from fossil fuels, the European Union is the third largest emitter of CO_2, after China and the United States (See Figure 1).

Figure 1 | Yearly emissions in million Mt CO_2, 1960 and 2019, top ten global emitters in 2019.



Note: Territorial CO_2 emissions from fossil fuels.
Source: UNCTAD based on data from Global Carbon Project
http://www.globalcarbonatlas.org/en/CO2-emissions

6 European Parliament resolutions are not legally binding for other European institutions. However, they express a political position by Parliament members and can make a call for action on a particular subject matter under the competence of the Parliament.

The resolution underlines that all products under the ETS should be included. The sectors already considered by 2023 would include the power sector and energy-intensive industrial sectors, such as cement, steel, aluminium, oil refinery, paper, glass, chemical and fertilisers. These sectors represent 94 per cent of industrial CO_2 emissions of the European Union and continue to receive substantial free allocations in the ETS (European Parliament, 2021a).

In terms of country coverage, it is likely that non-members of the European Union that participate in the ETS (Iceland, Liechtenstein and Norway) or that have similar cap-and-trade systems linked to the ETS (Switzerland), would be exempt from the CBAM. The resolution adopted by the European Parliament also stresses that LDCs and SIDS should be given special treatment to consider their specificities and the potential negative effects of the CBAM on their development (European Parliament, 2021a). Therefore, it is expected that these countries will be exempt from the mechanism, especially considering their low contribution to current and historical CO_2 emissions. This will ensure that the CBAM does not penalise the exports of LDCs.

The resolution requests that the revenue raised from the implementation of the CBAM should be used to step up the European Union support for the objectives of the Green Deal. Further, it stresses that mechanism should not be misused to further trade protectionism (European Parliament, 2021b). However, several countries have already raised concerns in different trade fora, such as UNCTAD and WTO about the implementation of a CBAM, particularly regarding the potential creation of trade distortions and the need to implement special treatment to LDCs.[7] Moreover, considering the cumulative contribution of the European Union and the United States to CO_2 emissions, countries such as China, Brazil, India, and South Africa continue to argue that the primary obligation to reduce emissions falls upon developed countries. For some countries, the CBAM could be seen as going against the principle of common but differentiated responsibilities (UNCTAD, 2021).

The CBAM will affect exporters to the European Union in sectors with a high risk of carbon leakage according to CO_2 content embedded in their products. The European Parliament's resolution stresses that the CBAM should consider that the carbon pricing of imports should cover both direct and indirect emissions.[8] This means that it should also take into account the country-specific carbon intensity of the electricity grid (European Parliament, 2021a). Although the details of the CBAM are unknown, the European Parliament is of the opinion that the CBAM should allow importers to buy allowances from a "EU ETS like" system and that an evolving tax that automatically mirrors the price of the ETS would be theoretically like the ETS. The Parliament also stressed that the CBAM should ensure that importers from third countries are not charged twice for the carbon content of their products to ensure that they are treated on an equal footing and avoid discrimination (European Parliament, 2021a).

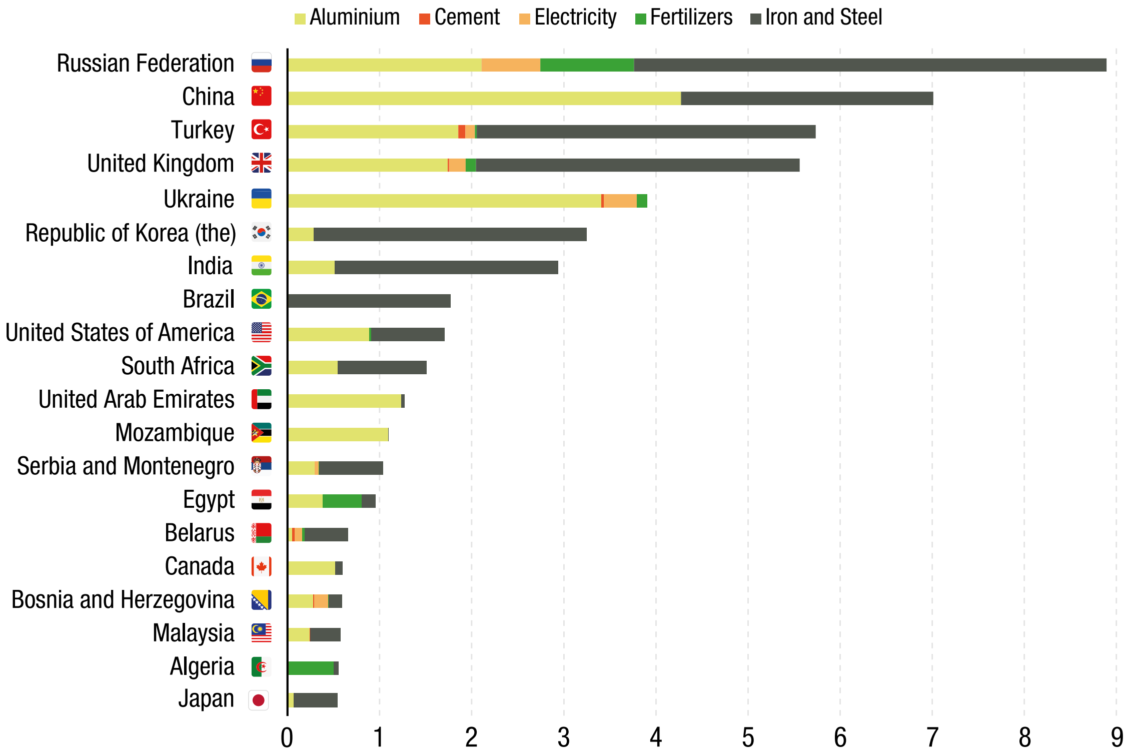
Figure 2 shows the list of countries with the highest levels of exports to the European Union in selected sectors likely to be included in the CBAM. From this view, the Russian Federation, China and Turkey are the countries most exposed to the mechanism. The effective impact of the CBAM on exports of these sectors to the European Union will depend on the level of carbon emissions embedded in exports and the carbon prices already paid in the countries of origin, if any. Considering the level of exports to the European Union in these sectors, the developing countries most exposed to the CBAM would be India, Brazil and South Africa, while Mozambique would be the most exposed LDC.

7 See footnote 4.

8 The GHG Protocol categorises GHC emissions between direct and indirect: Direct emissions are those from sources owned or controlled by the reporting entity. Indirect emissions are those emissions that are consequence of the activities of the reporting entity but occur at sources owned or controlled by another entity. See https://ghgprotocol.org/calculationg-tools-faq.

TABLE OF CONTENT

Figure 2 | Exports to the European Union 2019 in selected sectors likely to be considered in the CBAM.
20 most exposed countries in terms of aggregated value of exports (billion $)



Source: UNCTAD based on UN COMTRADE. The list does not include Iceland, Norway and Switzerland because they participate in, or are linked to, the ETS. Therefore, it is likely that these countries are exempt from the mechanism.

Potential effects of a CBAM: a literature overview

Effects on reducing leakage

Many quantitative studies have analysed CBAM as a measure to help prevent carbon leakage. Branger and Quirion (2014) conducted a meta-analysis of 25 studies examining the impact of carbon border adjustments (CBAs) on carbon leakage and competitiveness. Their findings show carbon leakage estimates ranging from 5 to 25 per cent (mean 14 per cent) without policy and from -5 per cent to 15 per cent (mean 6 per cent) with CBAs.

In their summary from the results of 12 computable general equilibrium (CGE) models elaborated in the context of the Energy Modelling Forum 29, Böhringer, et al. (2012) found that introducing a border adjustment tax results in carbon leakage reductions that vary between 2 per cent and 12 per cent. In terms of coverage and efficiency, the extension of CBAs to all sectors and the inclusion of export rebates would be the most efficient features to reduce the leakage ratio (Branger and Quirion, 2014).

In any case, carbon leakage is not homogeneous throughout the economy. High-energy sectors exposed to trade, such as cement, steel, and aluminium, show considerable higher leakage rates (Mehling et al., 2019). To prevent leakage, the ETS allocates free allowances to the sectors with higher risks of carbon leakage such as chemicals, cement and lime, iron and steel, and mineral oil (European Union, 2020).

In terms of the CBAM implementation, the only practical experience with a CBAM is in California's electrical sector (with a cap-and-trade system). Pauer (2018) argues that the system has not reduced carbon leakage due to "resource reshuffling". The reshuffling occurs when importers of electricity can ensure their imports are contractually low carbon, while users in jurisdictions with different regulations consume high-carbon generation. According to this author, the impact of resource reshuffling could even offset the CBAM reductions. The experience of California highlights the challenges of implementing a CBAM (Pauer, 2018; OECD, 2020).

Effects on international trade

The CBAM would apply a carbon-related charge to the import of goods from sectors at risk of carbon leakage from countries with lower environmental ambitions and regulations than the European Union. The mechanism would reflect the costs that the European Union imposes on domestic producers under its ETS. Importers already paying carbon prices in their countries of origin would not be charged twice for the carbon content of their products (European Parliament, 2021a).

TABLE OF CONTENT

The effects of the CBAM will depend on trade patterns, carbon intensity of production processes of countries, and carbon policies of European Union's trade partners. Studies show that carbon tariffs can create adverse distributional effects for countries subject to the measure (Branger and Quirion, 2014) and exacerbate regional inequality (Böhringer et al., 2012). Exporters of fossil fuels are negatively affected by carbon border measures due to downward pressure on fuel prices as global fuel consumption falls. In comparison, importers of emissions-intensive trade-exposed (EITE) sectors from the group of countries imposing the adjustment suffer from higher EITE import prices.

Estimates indicate that if the CBAM is applied to all the goods covered by the ETS, up to $16 billion of developing country exports to the European Union could face an additional charge (Lowe, 2021). CO_2 imported from these economies only represents a small proportion of the CO_2 embodied in the total imports of the European Union. For instance, imported CO_2 from India only represents around 1 per cent of total imports (Lowe, 2021). This author finds that only imports of stone, plaster and cement from developing countries account for over 10 per cent of total European Union imports in the sectors considered for CBAM, arguing that exempting these economies from the CBAM would not be particularly costly for the European Union in the context of total imports. The application of a CBAM could impact the development of poorer countries and reduce their opportunities for export-led development, particularly if countries with carbon taxes and greener production processes are exempted from the CBAM.

Some studies have attempted to determine which developing countries would be affected negatively by an EU-wide CBAM. For instance, Brandi (2013) considered trade flows between the European Union and developing countries based on data on imports from energy-intense sectors extracted from the United Nations Comtrade database. She identified that Low Income Countries (LICs), such as Tajikistan and Zimbabwe, and LDCs, such as Mozambique, were particularly vulnerable to a CBAM implemented by the European Union because they tend to export more EITE products to the European Union. However, she noted that while exports to the European Union constitute a relatively low share of total production of most LICs and LDCs, exports from EITE industries provide a substantial source of employment and income for local people. If CBAs are applied, they could limit market access of these countries and potentially increase poverty levels (Brandi, 2013).

A similar analysis conducted by the Boston Consulting Group estimated the loss in profit in selected EITE sectors by calculating imports of the European Union and financial and competitiveness impact of the application of carbon border tax of $30 per metric ton of CO_2. They found that the CBAM could impact countries' trade competitiveness depending on their production processes' emissions levels and trade intensity. For instance, in the case of steel, China and the Russian Federation would be more affected due to high carbon intensity in production. At the same time, Turkey and India would become more attractive due to low carbon production processes in this sector (BCG, 2020).

Even though the CBAM will most likely spare LDCs and SIDS, it is important to consider the impact that this measure will have in LICs that export to the European Union. Zimmer and Holzhausen (2020) ranked the economies of LICs according to their total exposure to the CBAM.[9] The authors find that the implementation of a CBAM would create important costs for developing economies, particularly African trade partners and the Arab states of the Persian Gulf, because these economies would be faced with significant tariffs considering the carbon emissions associated with their products (Zimmer and Holzhausen, 2020). Their analysis finds that the most affected lower-income economies include the African fuel-exporting countries such as Cameroon, Egypt, and Nigeria. Other African economies such as the Congo, Ghana, Morocco and Zimbabwe would also be affected due to the relative importance of their exports affected by the CBAM.

9 The authors define 'total exposure' as the product of the carbon tariff on 'brown' exports to the European Union and the share of 'brown' exports in total exports to the European Union.

The model

Modelling Carbon Border Adjustment Mechanism in GTAP

Computable general equilibrium (CGE) models provide a framework to simulate policy changes and trace the impact on key economic variables. CGE models are widely used to assess the effects of trade policy changes on the environment as well as on production, trade patterns, welfare and other economic variables. The models capture intersectoral relationships as specified in national input-output tables showing the inputs used in production in economic sectors for each country, and link countries through bilateral trade in goods and services. Transport costs are reflected in the model by distinguishing between free on board and cost insurance, and freight charges prices. They are designed to show the economy wide effects of changes in taxes, tariffs, productivity and other exogenous shocks. The CGE model used here is the latest version of the GTAP Model, a multi-country and multi-sectoral model fully documented in Hertel and Tsigas (1997) and Corong et al. (2017). GTAP covers the entire world economy with detailed data for 147 regions and 65 sectors.

The GTAP Energy-Environment version GTAP-E with its CO_2 emissions module incorporates carbon emissions from the fossil fuels combustion and industrial processes (Corong et al., 2020). The model links data on fossil-fuel related CO_2 emissions to economic activity in each sector and country. GTAP-E allows for an assessment of certain environmental instruments such as carbon taxes. We have further extended the GTAP-E model to incorporate carbon border adjustment taxes, processes CO_2 emissions and CO_2-equivalent emissions from non-CO_2 emissions gases. The revised version permits imports to be taxed - based on the carbon emissions they contain - by an importing country implementing a CBAM.

Following Chepelieve et al. (2021), we implement the CBAM by setting a levy on the carbon content of imports (based on the carbon intensity of the country or origin) equal to the carbon price applied to a country's (e.g., European Union) production. This requires estimating the embedded carbon emissions of imports in the GTAP database to be used as a basis for simulating the border carbon tax applied to imports in a country or countries where a CBAM is in place.

In the first step, country specific carbon emissions per unit of output by industry are used to estimate carbon emissions associated with bilateral trade flows. We use direct emissions from production and indirect emissions from electricity in this paper (Scope 1 and Scope 2 emissions). This step also allows us to decompose carbon emissions from domestic output into its sales disposition, i.e., exports or domestic sales. For every commodity, the total CO_2 emissions associated with fossil-fuels combustion and energy use embodied in exports is calculated. For example, for steel production in China, 0.84 kg of CO_2 emissions is embedded in every dollar of steel exported; for cement production in Belarus, 7.15 kg of CO_2 emissions is embedded in every dollar of cement exports.

TABLE OF CONTENT

In the second step, based on these embedded carbon emissions in traded products, we calculate the corresponding CBA for each trading partner, adjusted by trade costs as the CBA is applied to import values. The carbon price per tonne of emitted CO_2 of the CBAM imposing economy is multiplied by the embodied carbon emissions for each sector in every exporting economy.[10] This provides an ad valorem equivalent of the CBA tax, i.e., expressed as a percentage of the value of imports. The CBA can then be handled by the GTAP-E model in the same vein as a tariff surcharge.

Model assumptions

In this application the GTAP database (V10.1)[11] is aggregated into 51 economies and 20 sectors. This includes the 27 member States of the European Union as one region, Norway, Switzerland and the United Kingdom, LDCs grouped by regions, SIDS, as well as large economies and other regions. The GTAP database has 46 goods categories. The model assumes that the sectors upon which the CBA is imposed are electricity and the energy intensive industries cement and glass, steel, aluminium, paper, petroleum and coal products, and chemicals and fertilisers.

These sectors have been kept as disaggregated as the GTAP database allows but are not as specific as the discussion in the European Union may imply. For example, aluminium is included in a broader product group that also includes other metals such as copper and nickel. Coal, oil, and gas are kept as separate sectors, while other sectors are aggregated into broader product groups.

In terms of country coverage, the model assumes that Norway and Switzerland are exempt from the CBAM because these countries participate in or are linked to ETS. It also considers that the United Kingdom is also exempted given that this country replaced its participation in the ETS on 1 January 2021 with its United Kingdom Emissions Trading Scheme,[12] and that both the European Union and the United Kingdom agreed in a post-Brexit trade deal to give "serious consideration" to linking their carbon markets.[13] The model assumes that these countries participate in climate policy of the European Union and therefore, and for the purposes of this paper, their results will be included in those of the European Union.

The CBA is directly proportional to the carbon price. The price of one tonne emitted CO_2 has varied largely over time, as well as by country within the European Union. The price of allowances in the ETS has also fluctuated. Between 2013 and 2020 the prices of allowances varied but increased from less than €3 to around €25 (European Court of Auditors, 2020). In this model, we assess carbon prices of $44 and $88. We assume that neither the European Union nor other countries had effective carbon pricing mechanisms in place in the base year (2014) that would reduce the internal carbon price or the CBA. Within the European Union, although the ETS was already in place, free allowances for energy intensive sectors and low carbon prices in many European Union countries led to a very low de facto carbon price.[14] Some trading partners had carbon prices in place but often only in certain regions within their jurisdiction.

The CBA varies significantly by country and product, indicating large differences in the carbon emissions embedded in productions. Table 1 and Table 2 portray this situation by showing the ad valorem equivalent for a carbon price of $44 per tonne of CO_2. There are large variations between and within sectors. Electricity, cement and glass, and steel and ferrous metals are among the sectors with the highest averages, reflecting higher carbon emissions embedded vis a vis other sectors, for instance paper products. The variation within sectors reflects the difference in carbon intensity due to differences in production technology. For instance, in cement and glass production, Belarus has a more carbon intense process than India, which in turn has a more carbon intense process than Singapore. These ad valorem equivalents will fall or rise proportionately with carbon price in the CBA importing country. Thus, a carbon price increase from $44 to $88 will double the CBAs uniformly across sectors and countries.

10 Although the precise characteristics and introduction methods of the CBAM will be proposed by the European Commission in July 2021, the European Parliament is of the opinion that importers should buy allowances from a separate pool of allowances to the EU ETS whose carbon price corresponds to that of the day of the transaction in the EU ETS (European Parliament, 2021a: 6). This means that the price of the mechanism would fluctuate.

11 The Version 10 database is documented in Aguiar et al. (2019).

12 See https://www.gov.uk/government/publications/participating-in-the-uk-ets.

13 See https://www.reuters.com/world/uk/britains-carbon-market-launch-with-missing-eu-link-2021-05-17/.

14 See World Bank 2021 (dashboard Carbon Pricing Dashboard | Up-to-date overview of carbon pricing initiatives (worldbank.org).

TABLE OF CONTENT

Table 1 | CBA ad valorem equivalent, at $44/ CO_2 tonne, by economy

Country	Paper Products	Aluminium	Steel, ferrous metals	Petroleum, Coal Prod.	Cement, Glass	Chemicals, Fertilizers	Electricity
Argentina	0.8	2.6	6.3	1.4	8.2	2.6	
Belarus	1.7	0.7	2.9	1.4	30.3	4.4	11.3
Brazil	0.8	4.4	3.3	0.9	7.0	0.8	
Canada	1.3	1.3	2.2	1.3	4.1	2.2	
China	1.7	2.4	3.7	2.3	10.3	3.0	
Chile	1.9	0.1	2.5	1.0	4.5	1.1	
Colombia	0.9	0.1	3.4	1.7	3.6	0.9	
Egypt	2.3	2.4	5.9	0.7	10.6	5.4	
India	4.0	5.6	12.6	0.9	22.1	4.6	
Indonesia	1.7	3.1	4.3	1.9	8.5	2.0	
Israel	0.3	1.5	2.5	1.3	4.0	0.6	
Japan	1.0	0.4	1.0	0.8	5.0	1.4	
Kazakstan	5.1	3.5	17.1	1.7	13.6	4.9	
Republic of Korea	1.0	0.6	1.5	0.8	4.8	1.2	
Malaysia	1.4	2.6	3.3	4.6	6.4	2.6	
Mexico	1.2	1.2	2.5	2.3	10.9	1.8	
Morocco	0.6	3.1	0.1	1.4	7.2	0.4	17.1
Peru	0.3	0.3	11.0	0.5	3.4	0.3	
Russian Federation	5.1	3.0	5.3	1.3	10.5	7.0	20.8
Saudi Arabia	6.1	4.9	2.7	1.0	6.9	6.9	
South Africa	1.7	6.4	6.2	10.4	11.7	4.2	
Singapore	0.3	1.4	3.5	0.6	1.6	1.3	
Thailand	2.8	0.4	2.2	0.2	13.5	1.5	
Turkey	1.1	1.2	2.9	1.2	12.3	2.0	16.6
Taiwan (Province of China)	1.8	0.4	1.1	0.7	3.5	2.0	
United Arab Emirates	3.1	0.8	1.9	0.7	7.6	3.7	
Ukraine	1.6	5.3	9.2	3.1	18.7	10.8	15.6
Uruguay	1.5	0.2	0.1	1.2	2.3	0.2	
United States of America	0.7	1.2	1.5	1.3	3.2	1.2	
Australia/New Zealand	1.4	5.5	2.2	2.0	3.2	2.2	
Serbia/Bosnia and Herzegovina	1.6	5.5	6.6	1.8	9.9	2.4	19.3

Note: The size of the bars is normalised by sector (column) and not for the whole table.
Source: UNCTAD based on GTAP emissions database.

Table 2 | CBA ad valorem equivalent, at \$44/ CO_2 tonne, by region.

Country	Paper Products	Aluminium	Steel, ferrous metals	Petroleum, Coal Prod.	Cement, Glass	Chemicals, Fertilizers
Rest of Central Asia	4.6	2.3	3.8	2.0	10.2	14.4
Rest of Central America	0.6	1.0	3.6	1.0	9.4	1.4
CES Africa	0.5	0.4	2.2	1.9	8.2	1.8
Rest of East Asia	5.5	8.3	37.7	3.9	35.4	12.1
Rest of Latin America	0.6	2.1	2.7	2.1	4.3	3.9
Rest of MENA	3.1	5.6	2.9	2.0	12.0	9.3
Rest of North Africa	1.8	2.6	6.7	2.9	5.7	6.0
Rest of South East Asia	3.5	1.0	4.9	1.3	18.5	2.0
Rest of South Asia	1.0	6.1	4.9	0.5	14.5	5.0
Rest of West Africa	1.0	1.0	7.1	7.9	33.4	3.4
Rest of the World	0.3	4.6	11.3	1.0	1.8	0.8

Note: The size of the bars is normalised by sector (column) and not for the whole table.
Source: UNCTAD based on GTAP emissions database.

Scenarios

To illustrate the potential impact of a CBAM, we simulate three main scenarios, described in Table 3 The first scenario simulates a uniform carbon price to emissions in energy-intensive and other sectors in the European Union. We assume a price of \$ 44 (Base \$44)[15] and \$88 (Base \$88) per tonne of carbon emissions for producers in the European Union. To isolate the effect of the CBAM, we take the new equilibrium after the shock from scenario 1 as the baseline to which subsequent scenarios are compared.

The second scenario introduces a CBAM with a carbon price of \$44 on each tonne of carbon emissions embedded in imports to the European Union. The CBAM is applied to the power and energy-intensive industrial sectors.

The third scenario undertakes a sensitivity analysis with a carbon price on CO_2 emissions of European Union's products and imports of power and energy-intensive sectors of \$88 per tonne of embedded carbon emissions.[16]

Table 3 | Alternative Scenarios

Scenario	Label	Description
1	Domestic carbon price (Base 44 and Base 88)	**The European Union imposes a domestic carbon price of \$44 per tonne of carbon emissions from fossil fuel combustion and industrial processes.** ▸ No other countries impose carbon prices to production.
2	CBAM 44	**In addition to domestic carbon price of \$44 per tonne of carbon emissions, a CBA is imposed on European Union's imports of electricity and products from energy intensive industries of \$44 per tonne of embedded carbon emissions.** ▸ LDCs and SIDS are exempt. ▸ No export rebate.
3	CBAM 88	**Like Scenario 2 with \$88 per tonne in the European Union's and CBA equivalent.**

15 This corresponds to the approximate price of Euros 40 per tonne of CO_2 at the moment of the approval of the resolution of the European Parliament on 10 March 2021.

16 This scenario is again based on a pre-simulation where the European Union imposes a carbon price of \$88 to embedded carbon emissions.

TABLE OF CONTENT


© ninuff- Adobe Stock

Model results

CO_2 emissions effects

Imposing a domestic price on CO_2 emissions in the European Union has an internal impact as well as on its trading partners (Scenario 1). The overall results are presented in Table 4 and country effects can be found in the Annex. CO_2 emissions in the European Union are reduced by 434 million metric tonnes ($MtCO_2$), this is, a 13 per cent reduction of their total emissions (Table 4). The reduction is partly offset by higher emissions in all other economies (58 million $MtCO_2$), a leakage of 13.3 per cent. The global net effect is a reduction in emissions by 376 million $MtCO_2$.

Table 4 | Reduction in CO_2 emissions by scenario, in millions of $MtCO_2$

Group	Base 44	CBAM 44	Base 88	CBAM 88
European Union	-434	9	-704	13
Other economies	58	-36	106	-59
Total	**-376**	**-27**	**-598**	**-45**
Development Classification				
Developed	-409	-4	-658	-10
Developing	33	-22	61	-35
Total	**-376**	**-27**	**-598**	**-45**
Vulnerable Groups				
LDCs	0.6	0.2	1.0	0.4
SIDS	0.5	0.2	0.9	0.4

Source: UNCTAD based on GTAP model simulation.

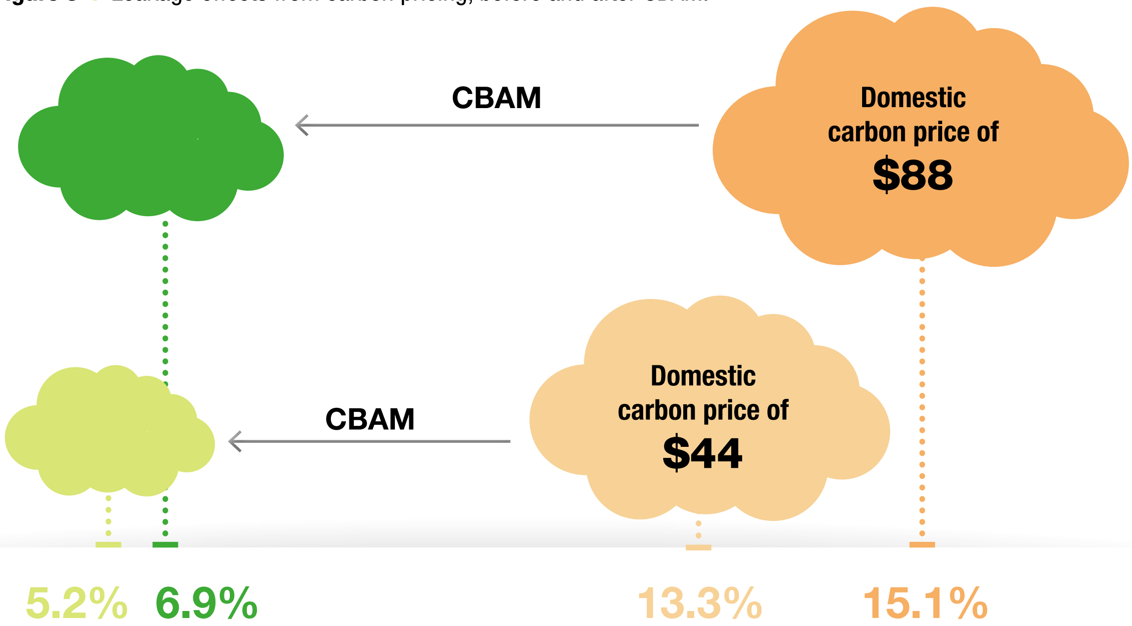
A CBA of $44 per tonne CO_2 embedded in the imports of power and energy intensive industries imposed by the European Union reduces global emissions further. Emissions by all countries outside of the European Union decrease by 36 million $MtCO_2$ and emissions in the European Union increase by 9 million $MtCO_2$. The emissions in the European Union increase because the production of energy intensive products is partly shifting back to the European Union. Thus, the CBAM reduces global CO_2 emissions by 27 million $MtCO_2$, a reduction of 0.1 per cent of global emissions or 0.9 per cent of European Union's emissions. This means reducing the leakage from 13.3 per cent to 5.2 per cent.

TABLE OF CONTENT

Applying a higher carbon price of $88 in the European Union, the corresponding higher CBA has a higher magnitude of gains and losses, following a similar pattern (Scenario 3: CBAM 88). Emissions in the European Union are reduced by 704 million MtCO_2 with a leakage of 106 million MtCO_2, 15.1 per cent, when the higher European Union domestic carbon price is imposed. The higher CBA reduces emissions outside of the European Union by 59 million MtCO_2, a 55 per cent reduction of the leakage.

The results show that the increase of carbon pricing in the European Union leads to a leakage of CO_2 emissions. The higher the carbon price, the higher the leakage. The introduction of a CBAM partially reduces the leakage, as shown in (Figure 3). For instance, at a domestic carbon price of $88, there is a leakage of 15.1%. The introduction of the CBAM reduces this leakage to only 6.9%.

Figure 3 | Leakage effects from carbon pricing, before and after CBAM.



Source: UNCTAD based on GTAP simulation.

Emission reductions from the introduction of the CBAM are relatively higher in economies where emissions increased after the introduction of a domestic carbon price in the European Union, such as Belarus, Serbia and Bosnia Herzegovina, Ukraine and some countries in Central Asia and Latin America. Reductions are highest in absolute terms in China, India, the Russian Federation, and to a lesser extent in Serbia and Bosnia and Herzegovina, as well as South Africa. Emissions increase in economies with lower CO_2 emissions per value of production of energy intensive products such as the European Union, but also Japan, the Republic of Kore and the United States. Although these countries also face the CBA (except the European Union), they are relatively more efficient in the use of CO_2 in production and thus gain in relative terms. LDCs and SIDS who are exempt from the CBA, only see a small increase in their emissions. Country effects can be found in the Annex.

TABLE OF CONTENT

Additional considerations, export rebates and free allowances.

Two additional assumptions were considered under Scenario 2. The first is the introduction of an export rebate for firms in the European Union, equivalent to $44 per tonne of CO_2 for exports of electricity and products from energy intensive industries. The second is the provision of 50 per cent of free allowances for CO_2 emissions for firms in the European Union alongside the application of the CBAM. However, since free allowances in the presence of the CBAM could constitute discrimination against foreign firms, the model assumes that the CBAM would provide the same free amount of carbon emissions for the same amount of goods to firms exporting to the European Union[17]. This assumption attempts to account for the possibility that free allowances continue and could coexist with the CBAM, at least for an interim period.

As an export rebate is introduced, the European Union increases its competitiveness. This would result in fewer imports from outside the European Union and the leakage would be reduced by nearly half, from 5.2 per cent to 2.6 per cent. As the more carbon efficient firms increase production, CO_2 emissions decrease by nearly 32 million $MtCO_2$, an additional reduction of 5 million $MtCO_2$ in comparison to the scenario without rebate.

The model shows that the introduction of free allowances counteracts efforts to reduce CO_2 emissions. The competitiveness effect helps to limit production declines in the European Union and by disproportionately higher border adjustments for CO_2 intensive imports, the leakage effect is fully addressed by the CBAM. However, under this scenario total emissions are only reduced by 225 million $MtCO_2$, in comparison to 402 million $MtCO_2$ in the absence of allowances, as they provide more incentives to firms, inside and outside of the European Union, to maintain the status quo, at least in the short run. The coexistence of free allowances and the CBAM is suboptimal in term of emissions and could also pose problems in terms of WTO compatibility, as it could be perceived as protectionist.

International trade effects

The higher carbon price in the European Union after the introduction of a $44 carbon price leads to a decline of domestic production, as well as a decrease in exports and an increase in imports for the most energy intensive products. Exports of the European Union decline between 0.21 and 5.6 per cent (Table 5). Global exports of non-European Union countries increase, except for oil products, where demand goes down. This result reflects the concern of some private sector groups and policy makers about a potential loss of competitiveness in energy intensive sectors.

The results show that in the absence of CBAM, developing countries as a group would benefit from an increase of carbon prices in the European Union by capturing part of the production of energy intensive products and increasing their exports. However, this effect is partially offset, under each of the scenarios, by the introduction of a CBAM. This reflects the concerns expressed by some developing countries that a CBAM would have an impact on their ability to export to the European Union. On the other hand, the exemption of LDCs and SIDS from the mechanism helps to slightly increase their exports in most sectors, albeit from a low base.

17 For example, if a firm in the European Union produces 10 tonnes of steel generating 100 $MtCO_2$, it will receive an allowance for 50 $MtCO_2$. If a firm outside the European Union produces 10 tonnes of steel but generating 200 $MtCO_2$, it will receive an allowance for 50 $MtCO_2$, not for the 50% of its emissions.

TABLE OF CONTENT

Table 5 | Changes in exports of energy intensive products, per cent

	Paper Products	Petroleum, Coal Prod.	Chemicals, Fertilizers	Cement, Glass	Steel, ferrous metals	Aluminium	Electricity
Base 44							
European Union	-0,21	-5,60	-1,30	-1,48	-1,08	-0,33	-3,79
Other	0,37	-0,73	0,96	1,35	1,23	0,77	11,02
Developed	-0,02	-3,04	-0,48	-0,69	-0,09	0,11	-0,89
Developing	0,35	-0,35	0,94	1,32	1,09	0,72	10,09
LDC	0,87	0,72	0,75	1,48	1,13	0,63	3,69
SIDS	0,54	-0,30	1,37	1,39	1,70	1,14	18,13
CBAM 44							
European Union	0,38	1,14	1,97	4,46	2,71	1,86	4,23
Other	-0,62	-0,67	-1,45	-4,62	-1,90	-1,09	-14,30
Developed	0,12	-0,10	0,68	2,48	0,71	0,60	-0,31
Developing	-0,78	-0,52	-1,35	-5,29	-1,68	-0,85	-11,22
LDC	-0,75	-0,00	0,59	0,48	-0,43	1,64	-1,71
SIDS	0,00	0,10	0,72	0,46	0,86	1,53	3,07
Base 88							
European Union	-0,39	-10,46	-2,40	-2,76	-1,95	-0,45	-6,20
Other	0,64	-1,36	1,79	2,51	2,27	1,38	20,88
Developed	-0,06	-5,66	-0,89	-1,28	-0,13	0,29	-0,83
Developing	0,62	-0,63	1,76	2,46	2,04	1,30	18,88
LDC	0,96	1,50	1,47	2,71	2,11	1,12	6,43
SIDS	1,09	-0,53	2,53	2,78	3,15	2,04	35,23
CBAM 88							
European Union	0,75	2,32	3,74	7,72	5,08	3,66	7,63
Other	-1,19	-1,23	-2,63	-7,47	-3,37	-2,03	-22,03
Developed	0,25	-0,15	1,30	4,15	1,37	1,17	-0,46
Developing	-1,52	-0,93	-2,44	-8,35	-2,95	-1,51	-16,57
LDC	-0,76	-0,07	1,05	0,86	-0,85	3,13	-2,84
SIDS	0,00	0,20	1,26	0,45	1,65	3,00	5,36

Source: UNCTAD based on GTAP simulation.

The CBAM partly reverses the effects of the domestic carbon price in the European Union. Exports increase in the European Union's most energy intensive sectors while as a group, other countries' exports in these sectors decline. Some economies experience significant export reductions in energy intensive sectors. These include the Russian Federation, Serbia and Bosnia Herzegovina, Ukraine, Central Asia, Egypt, South Africa, and the regions Rest of East Asia and Rest of South Asia (Annex). Global export values of exempted LDCs and SIDS, and from a few relatively energy efficient countries, increase by about 1 per cent.

A look at bilateral trade reveals that the European Union significantly increases intra-regional trade and all other regions reduce trade with the European Union, while often increasing trade with other regions. Thus, the CBAM has the equivalent effect as a tariff increase by a trading block, increasing intra-block trade and diverting trade of trading partners to other regions.

TABLE OF CONTENT

Income effects

The income effect is negative in the countries increasing carbon prices. The loss in real income is about $53 billion annually (Table 6). For all other countries, the aggregated effect is negligible, a gain of about US$3 billion. Countries benefitting in terms of real income include the United States, China, Japan, Republic of Korea and India, while the countries experiencing losses include the Russian Federation, Saudi Arabia, and countries in North Africa and Middle East. These countries are exporters of fossil fuels where demand, in particular in the European Union, would decrease.

Table 6 | Change in Real Income, by scenarios, (millions of US$)

Group	Base 44	CBAM 44	Base 88	CBAM 88
European Union	-52 847	4 591	-111 046	5 929
Other	2 652	-7 973	6 578	-14 200
Total	**-50 195**	**-3 382**	**-104 467**	**-8 271**
Development Classification				
Developed	-51 370	2 485	-107 070	1 937
Developing	1 175	-5 867	2 603	-10 208
Total	**-50 195**	**-3 381**	**-104 467**	**-8 270**
Vulnerable Groups				
LDCs	16	332	39	628
SIDS	25	76	61	151

Source: UNCTAD based on GTAP simulation.

With the introduction of the CBAM, global real income falls further by $3.4 billion, with some regions benefitting and some having higher losses. The European Union reverses some of the economic losses occurring from the carbon price increase, while as a group, other countries lose. The global reduction of CO_2 emissions associated with higher carbon prices in the European Union and the introduction of a CBAM has distributional effects and a net-economic price of about 0.07 per cent of global gross domestic product (GDP) (carbon price of $44). A few countries would benefit, such as Japan, Thailand, the Republic of Korea, the United States and some Latin American countries.

Gains in the European Union from the introduction of a CBAM stem from positive terms of trade effects compensating for allocative efficiency losses from rising tariffs. A positive terms of trade effect means that export prices increase relative to import prices, which in turns allows countries to buy a higher import quantity for the same export quantity. The terms of trade effect is positive when tariffs are raised and no retaliatory measures are taken. Allocative efficiency losses stem from market distortions moving resources to less productive activities.

Income effects are positive for the economies that are exempt from the CBAM: LDCs and SIDS. The regions experiencing income losses from an introduction of a CBAM include Oceania (with Australia dominating that region), India, Serbia and Bosnia and Herzegovina, Russian Federation, Ukraine, Saudi Arabia, South Africa and other countries in the Middle East, and to a lesser extent Brazil, Canada, China and Turkey.

The gains and losses from the CBAM are, however, small compared to the $53 billion losses in real income that the European Union experiences as a result of imposing a domestic carbon price of $44 per tonne of CO_2 emissions in their economies.

TABLE OF CONTENT

Employment effects

A policy shock like the introduction of a CBAM leads to changes in labour demand and wages. The application used here for assessing the effects of CBAM allows for an increase or decrease in demand for unskilled labour and a change in real wages of skilled labour. Labour and capital are mobile across sectors within a country but immobile internationally.

The impact of the introduction of the CBAM on employment follows the change in economic activities in the economies.[18] The employment and wage effects are small in the vast majority of the economies, well below 0.1 per cent. The CBAM could increase unemployment in those countries whose exports to the European Union are dominated by products that face the CBA such as, Kazakhstan, Serbia and Bosnia and Herzegovina, Saudi Arabia and Ukraine, as well as those countries in the regional groups of North Africa and Central Asia. Unemployment also increases in the European Union's trade partners due to higher import costs. On the other hand, unemployment decreases in countries that produce energy intensive products with relatively less CO_2 emissions as well as in LDCs and the SIDS.

18 Our assumptions about the labour market are standard assumptions made in the CGE literature. Assumptions made for the labour market can impact the results of employment and wage changes significantly. Vanzetti and Peters (2013) demonstrate the effects on welfare and other variables from trade liberalization if the adjustment occurs through employment or wages or both, and discuss other literature on this. The direction of the changes of trade and welfare is mostly not dependent on the labour market assumptions, the magnitude of certain variables, however, is.

TABLE OF CONTENT

Implications and Conclusions

This paper used an energy-oriented GTAP model to estimate three key parameters that characterise the imposition of carbon prices on European Union producers in carbon intensive sectors, with and without concomitant European Union implementation of a CBAM. These parameters were: CO_2 emissions reductions, carbon leakage outside of the European Union, and the extent to which trade and production may be affected for both countries inside and outside of the European Union. Analysis confirms the expected behaviour of these parameters, namely that CO_2 emissions of European Union producers decline, carbon leakage is reduced by a CBAM, and that trade patterns change in favour of countries where production is relatively carbon efficient compared to other countries. Additionally, the paper outlines the effects of these instruments on welfare and employment.

With the imposition of carbon taxes, the magnitude of emissions reductions and production losses are significant in the European Union, and without synchronous implementation of a CBAM, the European Union would experience substantial carbon leakage and export declines. With a $44 per tonne carbon tax, leakage is cut by more than half, from 13.3 to 5.2 per cent, suggesting that the CBAM can be an effective instrument for substantially reducing carbon leakage. Relative to a European Union carbon tax only scenario, the CBAM reduces carbon leakage and enhances European Union exports, but it does not completely eliminate either of these carbon tax effects on the economy of the European Union.

The CBAM's value in mitigating climate change is limited. Whereas a potential European Union domestic carbon price of $44 on all emissions reduces its global emissions by 13 per cent – and by 21 per cent in the case of a carbon price of $88 – the introduction of the CBAM adds another 0.8 to 1.3 percentage points. So, in the event that the European Union ultimately deploys these instruments, estimations suggest that their positive effect on reducing CO_2 emissions will come mainly from the domestic carbon pricing. The sensitivity of production to carbon taxes observed in the European Union in the model strongly suggests that for a scenario in which a carbon tax is imposed globally–in all countries and to all sectors–total global emissions reductions would fall substantially. Certainly, in such a case CBAMs would ultimately become superfluous and unnecessary.

Many of the European Union's trading partners exporting carbon intensive goods have raised concerns that a European Union CBAM would substantially curtail their exports. This paper suggests that for most countries this will not be the case. The simple average reduction in exports by developing countries across the targeted carbon intensive sectors is only 1.4 per cent when the CBAM is implemented with a $44 per tonne tax, and just under 2.4 per cent when implemented by an $88 per tonne tax. It must be pointed out that in these two scenarios, however, developed countries do not suffer export declines. This is expected since developed country producers, as a whole, employ less carbon intensive production methods in the targeted sectors than their developing country counterparts.

TABLE OF CONTENT

The analysis also indicates that the CBAM generates a similar gap between developing and developed countries in terms of welfare. In both cases, developed countries fare better than developing countries. With a $44 per tonne carbon tax, developed country incomes rise by $2.5 billion while developing countries' incomes fall by $5.9 billion. Developed countries, however, experience a higher welfare loss, driven by losses in the European Union, from the initial introduction of the carbon price of $51 billion with a carbon price of $44, while developing countries gain $1 billion in the absence of a CBAM.

From a development perspective, a CBAM promotes the reduction of GHG emissions of trade partners, but it does not focus on how to pursue that endeavour. Reducing these emissions effectively will require more efficient production and transport processes. The European Union might consider deploying CBAM flanking policies capable of narrowing, and eventually eliminating, the gaps between developed and developing countries projected by the model. A potential aim of the European Union could include utilizing some of the revenue generated by the CBAM to accelerate the diffusion and uptake of cleaner production technologies in developing countries in the CBAM's targeted sectors.

Going forward, the European Union CBAM may have systemic implications, despite the relatively small effects of the CBAM on emission levels and on most trade flows. Countries with a comparable context to that of the European Union, such as the United States of America, might welcome the precedent and the knowledge of the legal and policy implications in practice. Others may follow suit to internalize carbon costs themselves rather than be subject to carbon prices in other jurisdictions.

References

Aguiar A, Chepeliev M, Corong EL, McDougall R and Mensbrugghe D van der (2019). The GTAP Data Base: Version 10. *Journal of Global Economic Analysis*. 4(1):1–27.

BCG (2020). How an EU Carbon Border Tax Could Jolt World Trade. Boston Consulting Group. (accessed 17 June 2021).

Böhringer C, Balistreri EJ and Rutherford TF (2012). The role of border carbon adjustment in unilateral climate policy: Overview of an Energy Modeling Forum study (EMF 29). *Energy Economics*. The Role of Border Carbon Adjustment in Unilateral Climate Policy: Results from EMF 29. 34S97–S110.

Brandi C (2013). Trade and Climate Change: Environmental, Economic and Ethical Perspectives on Border Carbon Adjustments. *Ethics, Policy & Environment.* 16(1):79–93, Routledge.

Branger F and Quirion P (2014). Would border carbon adjustments prevent carbon leakage and heavy industry competitiveness losses? Insights from a meta-analysis of recent economic studies. *Ecological Economics*. 99(C):29–39, Elsevier.

Chen J et al. (2020). EU Climate Mitigation Policy. No. 20/13. International Monetary Fund. (accessed 18 January 2021).

Chepeliev M et al. (2021). Possible Implications of the European Carbon Border Adjustment Mechanism for Ukraine and Other EU Trading Partners. *Energy RESEARCH LETTERS*. 2(1):1–6, Asia-Pacific Applied Economics Association.

Corong EL, Golub A, McDougall R and van der Mensbrugghe D (2020). GTAP-E model, version 7: an energy-environmental version of GTAP (manuscript). Center for Global Trade Analysis, Purdue University.

Corong EL, Hertel TW, McDougall R, Tsigas ME and Mensbrugghe D van der (2017). The Standard GTAP Model, Version 7. *Journal of Global Economic Analysis*. 2(1):1–119.

European Court of Auditors (2020). Special report 18/2020: The EU's Emissions Trading System: free allocation of allowances needed better targeting. European Court of Auditors.

European Parliament (2021a). European Parliament resolution of 10 March 2021 towards a WTO-compatible EU carbon border adjustment mechanism (2020/2043(INI)). Available at https://www.europarl.europa.eu/doceo/document/TA-9-2021-0071_EN.pdf (accessed 15 June 2021).

European Parliament (2021b). MEPs: Put a carbon price on certain EU imports to raise global climate ambition | News | European Parliament. (accessed 8 June 2021).

European Union (2020). Special report 18/2020: The EU's Emissions Trading System: free allocation of allowances needed better targeting. 53.

Hertel T and Tsigas M (1997). Structure of GTAP. *Center for Global Trade Analysis: Modeling and Applications*. Center for Global Trade AnalysisCambridge University Press. New York: chapter 2, pages 38-46.

IISD (2021). WTO Committee on Trade and Environment Discusses Efforts to Address Climate Change, Improve Sustainability | News | SDG Knowledge Hub | IISD. (accessed 16 June 2021).

Lowe S (2021). The EU's carbon border adjustment mechanism: How to make it work for developing countries. Centre for European Reform. (accessed 22 June 2021).

Mehling MA, Asselt H van, Das K, Droege S and Verkuijl C (2019). Designing Border Carbon Adjustments for Enhanced Climate Action. *American Journal of International Law*. 113(3):433–481, Cambridge University Press.

OECD (2020). The Climate Challenge and Trade: Would Border Carbon Adjustments Accelerate or Hinder Climate Action? - OECD. Background Paper for the 39th Round Table on Sustainable Development. OECD. (accessed 24 January 2021).

Pauer SU (2018). Including electricity imports in California's cap-and-trade program: A case study of a border carbon adjustment in practice. The Electricity Journal. Special Issue: Energy Policy Institute's Eighth Annual Energy Policy Research Conference. 31(10):39–45.

South African Government (2021). Joint Statement issued at the conclusion of the 30th BASIC Ministerial Meeting on Climate Change hosted by India on 8th April 2021 | South African Government April. Available at https://www.gov.za/nr/speeches/joint-statement-issued-conclusion-30th-basic-ministerial-meeting-climate-change-hosted (accessed 9 July 2021).

UNCTAD (2021). Climate change, green recovery and trade. UNCTAD. Geneva. (accessed 20 May 2021).

United Nations (2021). Smooth transition for graduating LDCs under the EU Carbon Border Adjustment Mechanism | LDC Portal. LDC Portal International Support Measures for Least Developed Countries. United Nations. (accessed 16 June 2021).

Vanzetti D and Peters R (2013). Trade and Agricultural Employment Linkages in General Equilibrium Modelling. *Shared Harvests: Agriculture, Trade, and Employment* (ILO-UNCTAD). ILO and UNCTAD. Geneva.

Zimmer M and Holzhausen A (2020). EU Carbon Border Adjustments and developing country exports: Saving the worst for the last. Allianz. (accessed 17 June 2021).

ANNEX

Change in CO_2 emissions, by scenario (million of $MtCO_2$)

Economy	Base 44	CBAM 44	Base 88	CBAM 88
Argentina	0,39	0	0,7	-0,01
Australia/New Zealand	0,39	-1,33	0,69	-2,26
Belarus	0,66	-0,79	1,25	-1,41
Brazil	1,4	-0,38	2,59	-0,71
Canada	0,39	-0,05	0,75	-0,13
Chile	0,24	0,02	0,43	0,04
China	6,37	-6,08	12,13	-10,17
Colombia	0,22	0,01	0,38	0,01
Egypt	0,23	-0,34	0,43	-0,61
India	3,56	-5,11	6,57	-7,81
Indonesia	0,8	0,18	1,45	0,3
Israel	0,71	-0,72	1,32	-1,2
Japan	3,57	1,3	6,49	2,26
Kazakhstan	0,63	-0,83	1,22	-1,24
Republic of Korea (the)	1,52	0,52	2,73	0,88
Malaysia	0,68	0,16	1,22	0,27
Mexico	0,48	-0,13	0,9	-0,23
Morocco	0,44	0,02	0,77	0,03
Mozambique	0,01	0,01	0,02	0,03
Norway	-4,64	-0,02	-8,21	-0,06
Peru	0,16	0,05	0,29	0,09
Russian Federation	5,37	-6,43	10,05	-11,5
Saudi Arabia	1,29	-0,68	2,42	-1,13
Serbia/Bosnia and Herzegovina	1,95	-3,57	3,64	-6,12
Singapore	0,26	0,04	0,48	0,06
South Africa	1,64	-2,04	2,93	-2,7
Switzerland	-3,14	0,03	-5,66	0,03
Taiwan (Province of China)	0,67	0,21	1,21	0,35
Thailand	0,37	-0,36	0,72	-0,58
Turkey	1,28	-1,01	2,32	-1,73
Ukraine	0,73	-3,07	1,37	-5,23
United Arab Emirates	0,21	-0,04	0,4	-0,08
United Kingdom	-58,6	0,24	-96,53	0,17
United States of America	11,22	1,38	20,22	2,18
Uruguay	0,03	0	0,07	0,01
Asia LDC	0,25	0,06	0,44	0,1
Central, East and South (CES) Africa	0,16	0	0,29	-0,01
CES Africa LDCs	0,18	0,08	0,33	0,15

TABLE OF CONTENT

Economy	Base 44	CBAM 44	Base 88	CBAM 88
EU_27	-367,41	8,86	-593,84	13,14
Rest of Central America	0,38	0,01	0,71	-0,01
Rest of Central Asia	1,18	-1,55	2,21	-2,47
Rest of East Asia	0,45	-0,84	0,84	-1,27
Rest of Latin America	1,48	-1,93	2,81	-3,09
Rest of MENA	3,75	-1,47	6,71	-2,32
Rest of North Africa	0,32	-0,57	0,59	-1,03
Rest of South Asia	0,51	-0,08	0,91	-0,13
Rest of Southeast Asia	0,57	-0,31	1,04	-0,44
Rest of West Africa	0,16	-0,05	0,31	-0,09
SIDS	0,46	0,19	0,85	0,37
West Africa LDCs	0,12	0,08	0,21	0,16
Rest of the World	0,04	-0,17	0,08	-0,3

Source: UNCTAD based on GTAP simulation.

Change in real Income, by scenario (millions of $)

Economy	Base 44	CBAM 44	Base 88	CBAM 88
Argentina	141,04	-39,55	268,12	-75,49
Australia/New Zealand	532,71	-788,02	1 107,58	-1 349,26
Belarus	174,58	-109,71	322,69	-199,24
Brazil	1 186,13	-444,3	2 308,68	-786,53
Canada	-9,32	-434,95	82,2	-851,53
Chile	120,9	63,26	225,82	119,81
China	3 938,92	-372,1	7 338,89	-752,13
Colombia	-296,53	-59,27	-497,76	-100,15
Egypt	-118,87	-218,97	-211,82	-391,09
India	1 508,22	-1 046,73	2 814,92	-1 675,53
Indonesia	133,44	-65,62	289,1	-117,8
Israel	319,64	-25,41	605,87	-65,39
Japan	3 248,99	1 547,83	6 009,81	2 758,56
Kazakhstan	-630,33	-207,11	-1 189,78	-351,99
Republic of Korea (the)	1 238,55	698,1	2 278,74	1 230,6
Malaysia	-139,64	-62,19	-239,75	-120,29
Mexico	-25,96	-33,35	-40,68	-53,42
Morocco	-8,46	23,22	-14,16	40,64
Mozambique	6,83	33,99	13,87	64,13
Norway	-2 268,34	-257,3	-4 382,6	-456,74
Peru	30,14	95,81	60,74	178,37
Russian Federation	-6 800,13	-1 356,13	-11 988,42	-2 501,46
Saudi Arabia	-1 681,49	-799,43	-3 126,05	-1 407,21
Serbia/Bosnia and Herzegovina	70,02	-949,1	156,92	-1 684,69
Singapore	-39,69	11,73	-80,61	14,33
South Africa	187,29	-816,03	367,46	-1 385,09

TABLE OF CONTENT

Economy	Base 44	CBAM 44	Base 88	CBAM 88
Switzerland	-790,72	-367,7	-1 552,12	-836,68
Taiwan (Province of China)	255,94	162,79	460,87	279,18
Thailand	252,17	47,99	476,26	85,47
Turkey	665,37	-398,1	1 227,14	-748,89
Ukraine	299,22	-1 194,71	558,38	-2 022,6
United Arab Emirates	-554,85	-283,42	-1 024,39	-513,6
United Kingdom	-7 215,54	209,9	-1 5645,73	44,11
United States of America	3 641,79	1 204,54	7 120,68	1 923,54
Uruguay	58,73	5,46	112,8	9,63
AsiaLDC	21,16	84,76	37,86	151,58
CES Africa	-532,34	-103,49	-979,31	-183,79
CES Africa LDCs	-18,92	66,99	-30,08	126,59
EU_27	-4 2572,49	5 006,1	-8 9465,23	7 178,66
Rest of Central America	151,84	50,24	282,79	85,21
Rest of Central Asia	-380,36	-349,53	-701,33	-607,97
Rest of East Asia	-62,3	-112,08	-104,97	-179,58
Rest of Latin America	-381,38	-177,43	-697,79	-325,9
Rest of MENA	-2 312,13	-1 058,27	-4 227,15	-1 860,67
Rest of North Africa	-892,97	-396,13	-1 633,27	-709,82
Rest of South Asia	158,47	7,36	299,94	15,05
Rest of Southeast Asia	-12,72	8,84	-18,01	26,96
Rest of West Africa	-850,06	-186,9	-1 573,89	-330,42
SIDS	25,11	75,96	61,44	151,4
West Africa LDCs	6,77	146,4	17,1	286,15
Rest of the World	26,53	-220,07	50,88	-395,73

Source: UNCTAD based on GTAP simulation.

Changes in exports of energy intensive products, per cent

Economy	Base 44	CBAM 44	Base 88	CBAM 88
Argentina	0,44	-1,22	0,79	-2,35
Belarus	0,64	-3,76	1,25	-6,80
Brazil	0,19	-1,49	0,34	-2,78
Canada	0,65	-0,04	1,17	-0,22
Chile	0,03	0,15	0,05	0,26
China	0,44	-1,98	0,82	-3,52
Colombia	1,76	0,22	2,91	0,42
Egypt	0,83	-4,96	1,54	-8,74
India	0,39	-2,91	0,74	-4,72
Indonesia	0,50	-0,54	0,87	-1,05
Israel	0,64	-1,76	1,23	-3,13
Japan	0,48	-0,28	0,88	-0,58
Kazakhstan	2,25	-2,32	4,25	-3,83

TABLE OF CONTENT

Economy	Base 44	CBAM 44	Base 88	CBAM 88
Republic of Korea	0,66	-0,15	1,24	-0,33
Malaysia	0,77	-0,60	1,42	-1,13
Mexico	0,47	-0,57	0,87	-1,11
Morocco	0,56	-1,06	1,13	-1,95
Mozambique	1,24	1,89	2,05	3,72
Norway	1,29	1,81	2,69	3,52
Peru	0,59	1,08	1,03	1,97
Russian Federation	1,18	-4,27	2,16	-7,69
Saudi Arabia	0,54	-1,31	1,02	-2,23
Singapore	0,53	-0,23	1,02	-0,47
South Africa	0,56	-4,51	1,01	-7,59
Switzerland	1,48	0,00	2,88	0,15
Taiwan (Province of China)	0,70	-0,10	1,31	-0,23
Thailand	0,72	-0,29	1,36	-0,47
Turkey	1,34	-3,12	2,52	-5,60
Ukraine	1,61	-7,52	2,97	-12,33
United Arab Emirates	0,77	0,08	1,43	0,11
United Kingdom	-0,10	1,61	0,03	3,12
United States of America	0,04	-0,62	0,06	-1,27
Uruguay	2,29	0,10	4,13	0,06
Australia/New Zealand	0,29	-2,63	0,40	-4,50
Serbia/Bosnia and Herzegovina	3,47	-15,01	6,75	-25,46
AsiaLDC	1,01	0,43	1,84	0,93
CES Africa	2,04	0,88	3,82	1,54
CES Africa LDCs	0,66	0,72	1,19	1,34
EU_27	-2,10	2,22	-3,87	4,21
Rest of Central America	1,13	-0,45	2,15	-1,01
Rest of Central Asia	2,23	-6,19	4,18	-10,54
Rest of East Asia	2,83	-15,92	5,29	-24,19
Rest of Latin America	1,27	-2,32	2,37	-3,99
Rest of MENA	0,79	-1,48	1,43	-2,45
Rest of North Africa	0,66	-4,67	1,22	-8,34
Rest of South Asia	1,02	-3,18	1,90	-5,44
Rest of Southeast Asia	0,82	-1,33	1,53	-2,13
Rest of West Africa	3,17	0,40	5,90	0,41
SIDS	0,78	0,64	1,46	1,22
West Africa LDCs	0,96	1,63	1,77	3,13
Rest of the World	1,29	-11,47	2,51	-20,49
Total	**-0,21**	**-0,20**	**-0,38**	**-0,29**

Source: UNCTAD based on GTAP simulation.

TABLE OF CONTENT

UNCTAD/OSG/INF/2021/2

@UNCTAD
@UNCTADtrade

UNCTAD – Division on International Trade and Commodities