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# The Global Impact of a Carbon Border Adjustment Mechanism

## A QUANTITATIVE ASSESSMENT

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## ABSTRACT

While the Carbon Border Adjustment Mechanism (CBAM) has a global impact by design, the scale of its "spillover effects" on other countries is seldom studied. This paper contributes to the academic and policy discussions by using a dynamic CGE model to assess quantitatively the impact of the CBAM on other countries, especially developing countries, and identify the countries that are most vulnerable to its spill-over effects. The simulation results suggest that the CBAM widens the gap between developed and developing countries in terms of GDP and welfare. For example, it may worsen the unequal income and welfare distributions between rich and poor economies, and further erode the capacity of some low-income countries to decarbonize their economies. To ensure a just low-carbon transition and prevent excessive negative impact on developing countries during the transition, the IMF should play the key role

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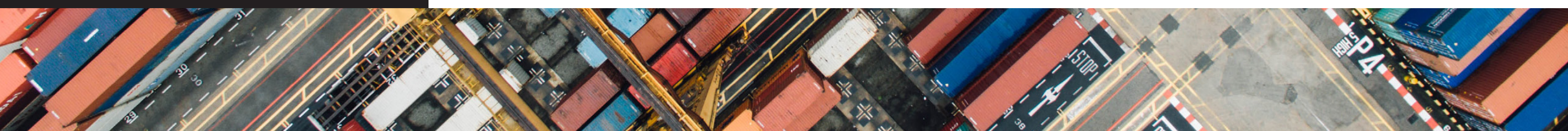

in identifying and addressing cross-border spillover effects of climate policies, especially those on balance of payments and growth trajectories of vulnerable countries. As an option to address this spillover impact, we briefly discussed the possibility of launching an Equitable Decarbonization Fund, from the proceeds of the CBAM to support decarbonization projects in low-income countries and the development of green technologies.

**Keywords:** Carbon Border Adjustment Mechanism, Transition Spillover Risks, Climate Change, International Monetary Fund

## MOTIVATION

Combating climate change requires coordinated global efforts, yet much of the current making of climate policies is led by developed countries. A case in point is the European Union (EU)'s ambitious climate change mitigation package being developed. To prevent carbon leakage, the EU adopted a resolution in 2021 to implement a Carbon Border Adjustment Mechanism (CBAM) as a part of the European Green Deal.

The CBAM will impose a levy on imported non-EU products that adjusts for the differences between the EU Emission Trading System (ETS) price and carbon price paid in the producing countries. The CBAM will come into force in January 2026 after a three-year transition.[2] Under the resolution, the CBAM will initially apply to imported electricity, cement, aluminium, fertilizer as well as iron and steel products, while all products under the ETS may be included in the long run. Under the current proposal, the CBAM will apply to direct greenhouse gas emissions (GHG) during the production process, the so-called "Scope 1 emissions." By the end of the three-year transition, the European Commission will evaluate the CBAM process and decide whether to broaden its coverage to more products and services, and whether to cover the so-called 'indirect' emissions, i.e., carbon emissions from the electricity used to produce the goods, including those further down the value chain (Scope 2 and Scope 3 emissions).

Carbon border tax has been debated in many countries over the past decade, and remains highly controversial. There are concerns that a unilateral EU CBAM will not only distort international trade, but also shift the burden of addressing climate change to developing countries. Many lower-income developing countries are slow in transitioning toward low-carbon economies, and they often rely more on the exports of carbon-intensive products. Some developing countries are the major exporters of carbon-intensive goods. For example, China, India and Russia are the top carbon net exporters, while developed countries such as the US, UK, Japan and European countries are carbon net importers. Many fear that developing countries risk being disproportionally burdened by the CBAM or similar policies initiated by developed

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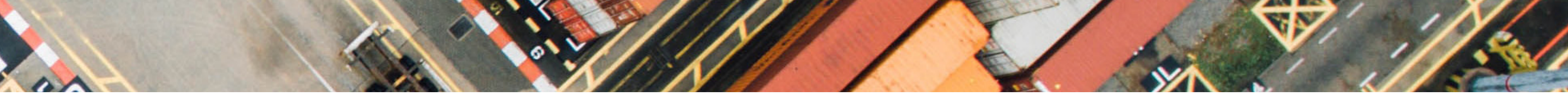
[2] European Commission. July 2021. Proposal for a Regulation of the European Parliament and of the Council: Establishing a Carbon Border Adjustment Mechanism.



countries. It is believed that, in the worse scenarios, these policies may exacerbate global inequality.

Designing climate policies without disproportionally hurting poorer economies is crucial in promoting equal prosperity across the globe. While the CBAM has a global impact by design, the scale of its “spillover effects” or “spillover transition risks” to other countries is seldom studied or presented.

This paper aims to contribute to the policy discussion by using a quantitative approach to assess the “spillover effects” of the CBAM and identify the vulnerable countries that are most likely to be impacted by such spillover effects. The objective of the research is to help inform further research and policy discussion on this issue, including those at the International Monetary Fund (IMF) on how to assist developing countries in responding to climate change and managing the impact of mitigation policies.

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## LITERATURE

Earlier studies on the effects of carbon border adjustment policies largely focused on evaluating their efficiencies in minimizing carbon leakage and reducing carbon emission. For example, Monjon and Quirionb (2011) evaluated the efficiencies of various border adjustment designs in limiting carbon leakage and concluded that a full border adjustment package with both export rebates and import tariffs was the most efficient. Weisbach et al. (2013) examined the impacts of various carbon border adjustment mechanisms in reducing emissions and reached similar conclusions. Gros (2009) used a partial equilibrium two-country model to show that a carbon import tariff would increase global welfare as it shifts production to importing countries while lowering environmental costs. Bao et al (2013) use a single country CGE model to study the impact of carbon border adjustments by the US and the EU on China’s carbon emission.

Another strand of literature focused on the trade effects and competitiveness. Tang et al. (2013) investigated the potential impact of carbon border adjustments by the EU and the US on international trade. The result of their simulation suggested that China’s exports would decrease significantly but imports would fall far more than exports, as its total income and demand both plunge.

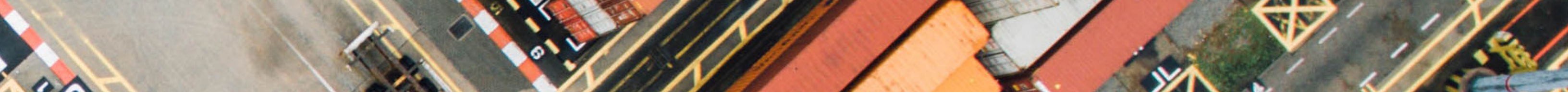
While recent studies had investigated the distributional effects of the CBAM, the literature remains inconclusive. Böhringer et al. (2018) showed that carbon border adjustments would exacerbate income inequalities as richer countries shift the burden of emissions abatement to poorer countries. Bruegel (2020) presented a literature review and suggested that carbon border adjustments, which give preferential treatment to clean domestic and foreign producers, may unduly affect developing countries. In fact, there is concern that the CBAM can significantly increase tensions between developed and developing countries in international climate negotiations. UNTCAD (2021) used a computable general equilibrium (CGE) model to study the distributional effect of a potential EU CBAM. However, these analyses were conducted before the release of the EU plan for the CBAM and, therefore, do not reflect the detailed specifications of the proposal.

As the EU rolled out the detailed proposal of the CBAM in July 2021, there has been a lively discussion about the global impact of the measure. To contribute to this discussion, we conducted a quantitative analysis using a global dynamic CGE model. Compared to the existing literatures, our model is calibrated to capture the key ingredients of the latest EU CBAM plan. Moreover, as many of the small countries are potentially vulnerable to the "spillover effects," our model is specifically tailored to circumvent a problem in the conventional CGE model and is thus better suited for studying the impact of the CBAM on small countries.

## THE MODEL AND SCENARIOS

Our model builds on the dynamic CGE models by Van der Mensbrugghe (2019) and Zhai (2018), and is calibrated to Global Trade Analysis Project (GTAP) database 10.0. In particular, we follow Van der Mensbrugghe (2019) in setting up the carbon emission module and the climate policy module. To calculate the carbon border taxes paid by the exporting countries and the tariff equivalents of the taxes, we need to use the carbon price of each country and the (embodied) carbon emission data of each sector of the country. Carbon price of each country can be imposed exogenously in the model. We set the EU's carbon price to be $75 (67€), as the average price between 2022 and 2030. This is a conservative assumption given the recent developments of the carbon prices. For the EU's trading partners, we use the carbon price data from the World Bank Carbon Pricing Dashboard. We use the sectoral level carbon emission data from the GTAP database as the default values for calculating carbon emission. This is consistent with the EU CBAM proposal, which states that using default values for the quantification of embedded emissions results in significantly lower compliance costs than basing the calculations on actual, monitored and verified emissions. The carbon border tax rate of a certain export good is calculated based on the differences between the carbon prices paid in the EU and the carbon prices paid in the country of origin. The carbon border taxes paid by the exporting countries are calculated by multiplying the sectoral embodied carbon emission by the tax rate. The tariff equivalents of the taxes are then calculated based on the carbon border taxes paid by the exporting countries and the value of the exporting goods.

We deviate from an important specification of Van der Mensbrugghe (2019). The traditional Armington specification in CGE models, which is also adopted by Van der Mensbrugghe (2019), has the effect of locking in pre-existing trade patterns and prevented the models from generating large changes in trade in sectors where little or no trade. Under this specification, if a country's imports of a product from another country are zero initially, they will always be zero, even after significant reductions of trade barriers. This "stuck on zero trade" problem makes traditional CGE models especially inappropriate for the small and low-income countries that usually have limited trade with the rest of the world. To address this problem, we follow Zhai (2008) to introduce the extensive margin to the trade sector. Specifically, we introduce the firm heterogeneity and fixed exporting costs in the trade sector to allow for extensive margin, and the patterns of trade are determined by various factors, such as market size, number of firms, technology and trade barriers, rather than the fixed "taste" parameters. Therefore, our model could generate meaningful changes in bilateral trade between regions where little bilateral trade exists initially.



We aggregate the sectors in the database into 29 aggregate sectors. Among the five categories of goods in the current CBAM proposal, electricity and iron and steel are well covered by the sectors in GTAP database. But due to the limitation in data disaggregation in GTAP, we use broader sectors to represent the other three categories of goods to be covered by the CBAM. Specifically, we use chemicals, non-metallic minerals and non-ferrous metals to represent fertilizer, cement and aluminium.[3]

To study the impact of the CBAM shock on non-EU countries and identify vulnerable countries/regions, we group different countries into 24 economies.[4] This will allow us to analyze the impact of the CBAM on relatively small economies. However, further disaggregation is difficult as it will result in computational difficulties.

The baseline of our analysis the case without the CBAM. It serves as a reference to derive the impact of CBAM., i.e., all simulation results (e.g., gross domestic product (GDP), exports, etc.) are reported as percentage changes from the baseline.

We consider two scenarios with the CBAM implemented and compare the simulation results with the baseline model. The first scenario simulates the effect of the current EU CBAM proposal. Only direct emissions (Scope 1) from the production of imported goods are used to calculate the carbon embodied in the imports. The second scenario assumes that the EU's CABM expands to all imported goods and services, and all indirect emissions from upstream value chains (Scope 3) are included in calculating the carbon contents. This is an "extreme case," as the future expansion of CBAM may or may not be able to cover all goods and using the widest definition of Scope 3 emissions due to technical difficulties especially on data collection and verification.

For both scenarios, we assume a carbon price of $75 on each ton of CO2 embodied in imports to the EU. We understand that there is a non-negligible possibility of carbon price exceeding $75 in the coming ten years.

Under both scenarios, the CBAM is imposed from 2026 onwards. We report the results of simulation for 2030 below and interpret it as the medium-run response to the policy change.

By intuition, countries that rely more heavily on exports of products affected by the CBAM (hereafter "CBAM exports" or "CBAM products") are likely to be impacted more than others, and countries with higher carbon intensity of their CBAM products tend to suffer more than others. The following two figures provide data on these two indicators: CBAM exports as percent of GDP by exporting country, and carbon intensity of CBAM products by exporting country.

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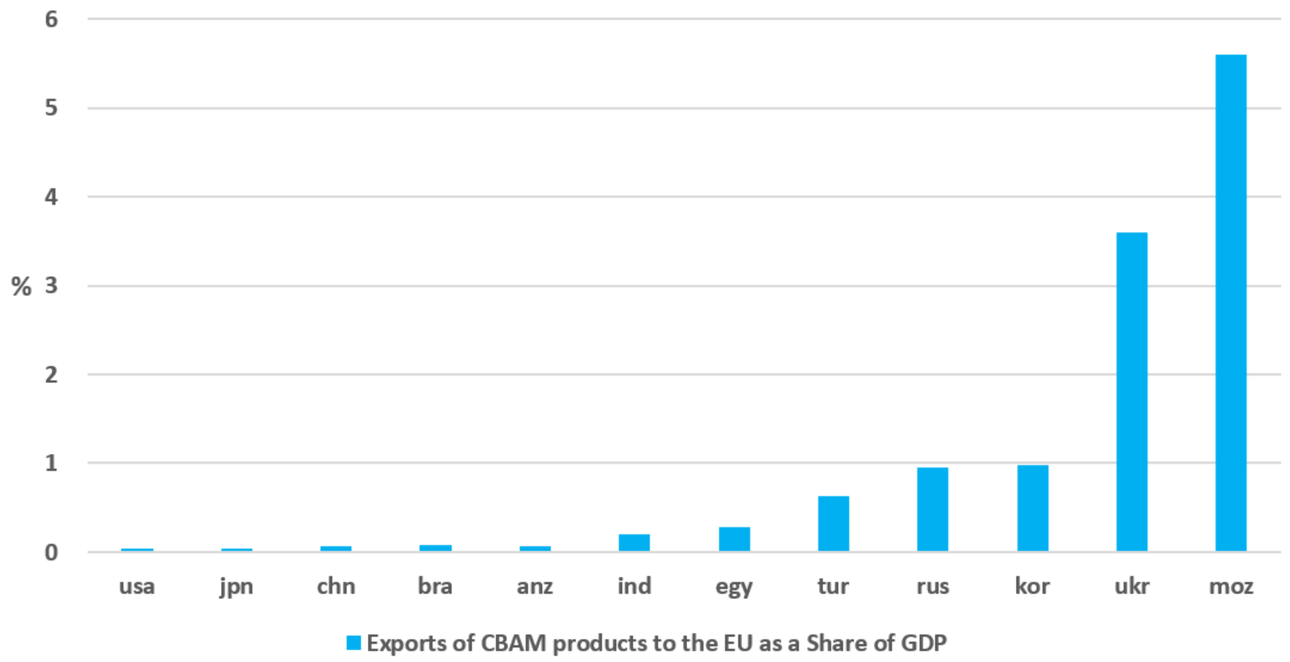
[3] It is worth noting that using broader sectors has two effects that could be offsetting each other. First, it will overestimate the product coverage of the CBAM and therefore overestimate the impact on trade flows. Second, it could underestimate the tariff equivalent of boarder adjustments for the specific products to be covered by CBAM.

[4] Australia and New Zealand (anz), Japan (jpn), Canada (can), United States of America (usa), South Korea (kor), China (chn), India (ind), Brazil (bra), Russia (rus), South Africa (zaf), Kazakhstan (kaz), Ukraine (ukr), Turkey (tur), Mexico (mex), Egypt (egy), Mozambique(moz), Association of South East Asian Nations (ASEAN), Latin American Countries (lac), Sub-saharan Africa (SSA), Middle East & North Africa (MENA), Least developed country (LDC), Rest of the world (row).

Figure 1 shows the share of exports of CBAM products as percent of GDP in selected exporting countries. Some of the developing countries are very small and their exports only constitute a very small share of EU imports, but the exports of carbon-intensive commodities constitute a significant share of these exporting countries' total GDP. Mozambique is a typical example, with aluminium and steel exports account for a large share of its GDP. Some of developed countries also export a fair large amount of carbon-intensive goods, such as the US as a major exporter of chemicals in dollar amount terms, but such exports constitute a very small share of its GDP (See Figure 1).

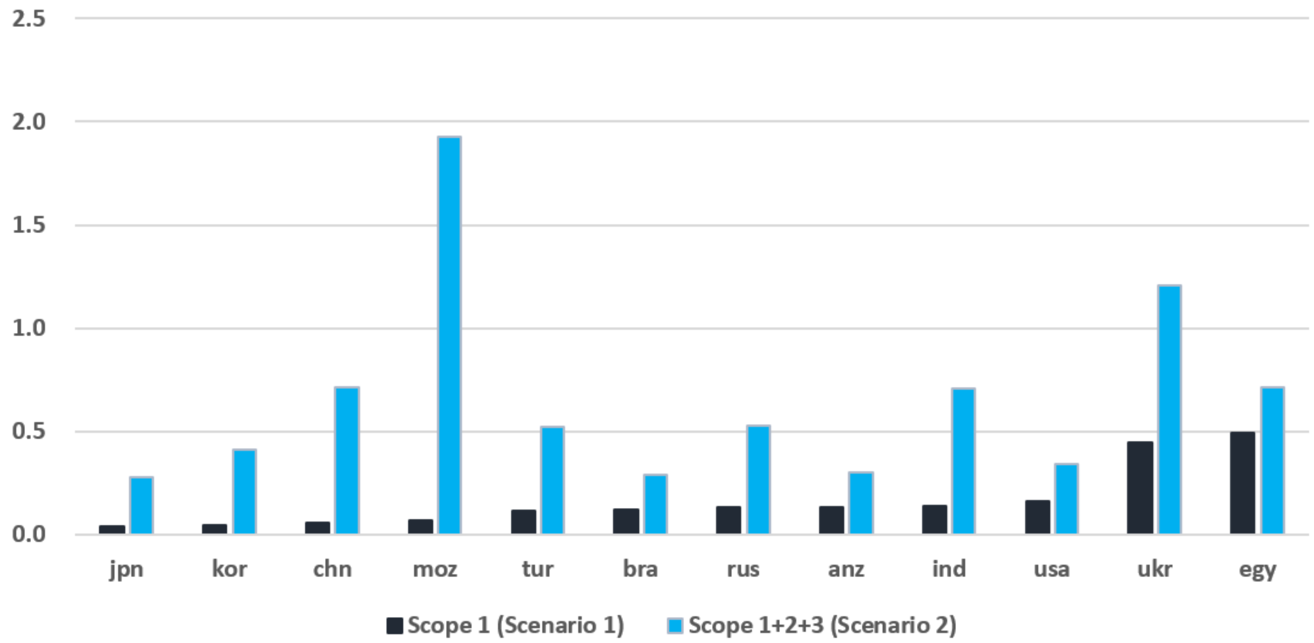
**FIGURE 1** Exports of CBAM products as % of GDP of exporting country




**Source:** UN comtrade and authors' calculations

Figure 2 shows the carbon intensity of total exports to the EU under Scenario 1 and Scenario 2, i.e., carbon emissions (in tons) per $1000 of exports. The variation of carbon intensity across countries reflects the differences in production technology, with low-income countries often employing more traditional technologies that are fossil fuel and carbon intensive.

**FIGURE 2** Carbon intensity of total exports to the EU (ton of C02/ $1000 of exports)




**Source:** GTAP 10 database and authors' calculations

## SIMULATION RESULTS

This section presents the simulation results under the above-mentioned two scenarios. We will focus on the impact of the CBAM on exports with the GDP of 24 economies considered in this model. Before deriving such impacts, we need to estimate the tariff equivalents of the CBAM for the 24 economies. Simulation results are presented in Figures 1 through 9 in this section and Tables 1 through 5 in the Appendix.

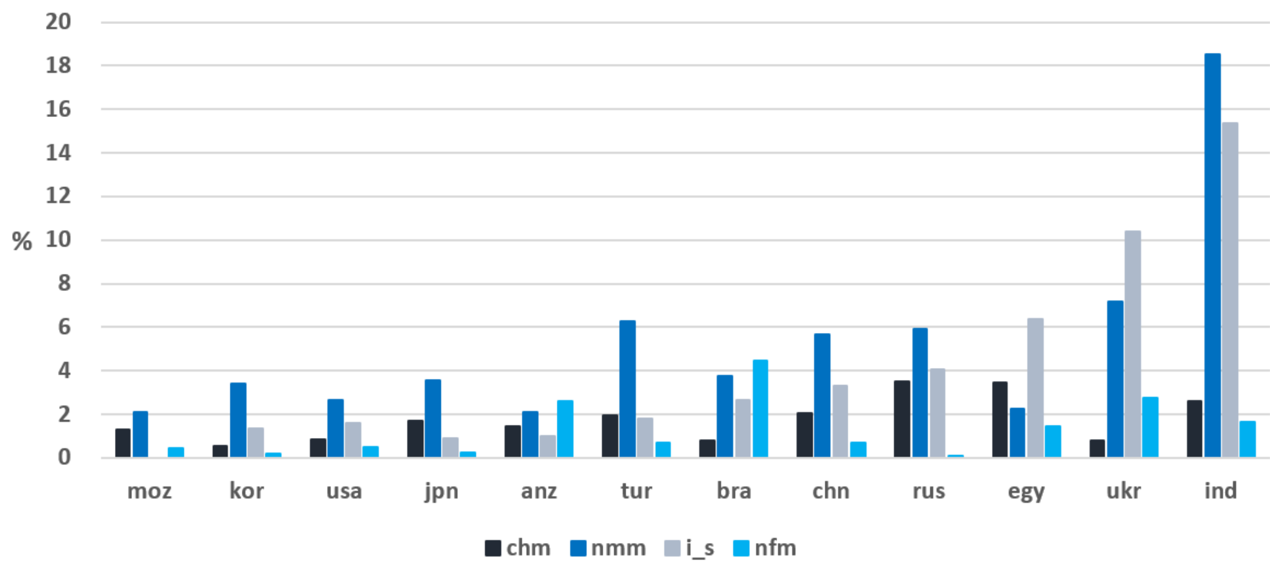
### Impact of the CBAM on exports

The simulation results show that the current version of the EU CBAM will lead to significant increases in costs (measured in tariff equivalents) of the imports of CBAM products from the EU perspective. For example, under Scenario 1, the tariff equivalents of CBAM on iron and steel exports from China, Russia and Brazil are between 3 and 4 percentage points compared with the baseline tariff levels, and for India it is about 15 percentage points. Our model shows that, as a result, the CBAM will lead to a decline in trade flows between those countries and the EU. For example, India's exports of iron and steel to the EU will fall by 58 percent compared with the baseline. Exports of iron and steel from China, Russia and Brazil to the EU will fall by more than 10 percent compared with the baseline.

Figure 4 shows the percentage decline in exports of CBAM products from some of the 24 economies. Almost all of them will experience a decline in exports but a few will see small increases due to relatively mild increases in tariff.[5] India, Ukraine, Egypt, Russia and China suffer from relatively larger losses (measured by precent change of exports from the baseline) in four main categories of CBAM exports to the EU. Developed countries such as the US and Japan also experience some increases in tariff equivalents, but the impact on their exports is mild.

Under Scenario 2, the CBAM covers all sectors, and the embodied emissions include both direct and indirect emissions down the value chain. Simulation results give a very different picture from Scenario 1. The tariff equivalents of CBAM increase significantly in most cases. This leads to significant declines in most countries' exports of CBAM products to the EU. For example, the exports of iron and steel to the EU from China and India fall by 50 percent and 84 percent, respectively, compared with the baseline. As a result of the CBAM, total exports from Mozambique to the EU fall by almost 68 percent, and those from China and India fall by 19 percent and 22 percent, respectively, compared with the baseline. With depressed demand, the terms of trade for these countries also deteriorates.

**FIGURE 3** Tariff Equivalents of CBAM: Scenario 1 (ppt change from baseline)




**Note:** Figures in the chart indicate the percentage point increases in tariff equivalent in 2030 due to the CBAM for exporting regions/sectors. Chm, nmm, i_s and nfm refer to chemicals(fertilizers), non-metallic metals(cement), iron and steel, and non-ferrous metals (aluminium), respectively.

**Source:** Authors' calculations based on CGE model

[5] Note that we exclude the changes in electricity exports (accounting for a small proportion of total CBAM exports) from figures in this paper, as their magnitudes are disproportionally large and would make it difficult to visualize the impacts of CBAM on other sectors. It is also worth noting that only a few countries (such as Russia and Ukraine) exports electricity to the EU.

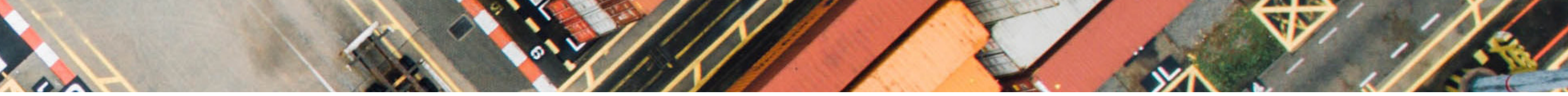
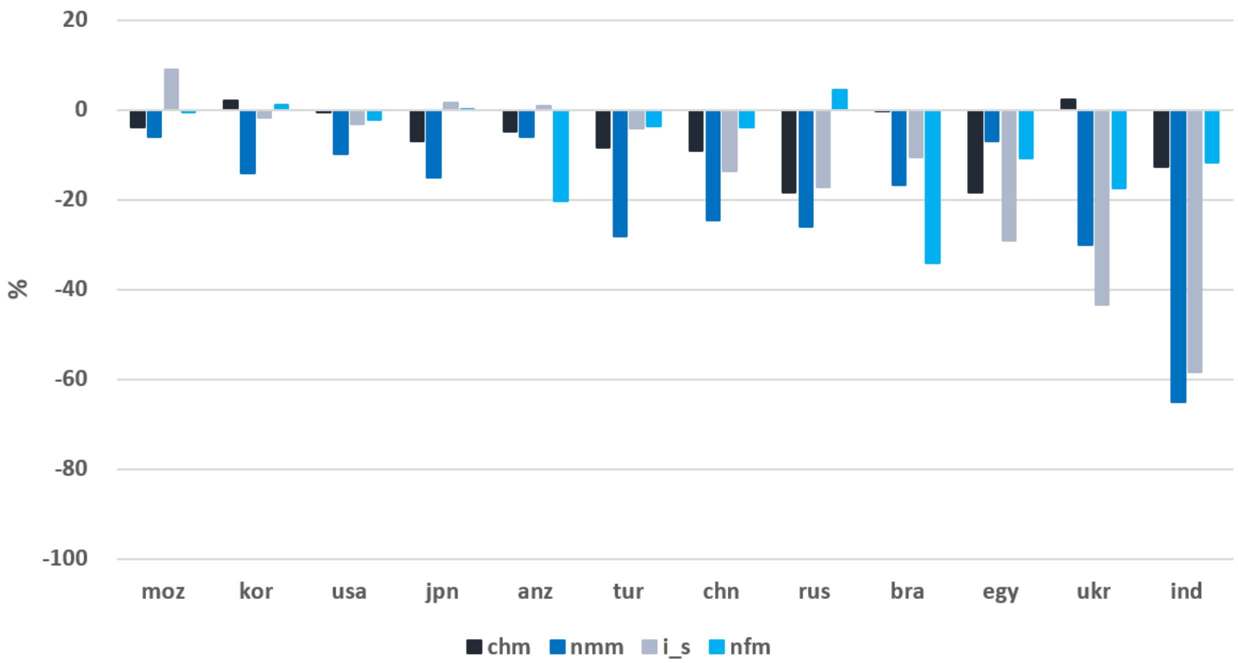


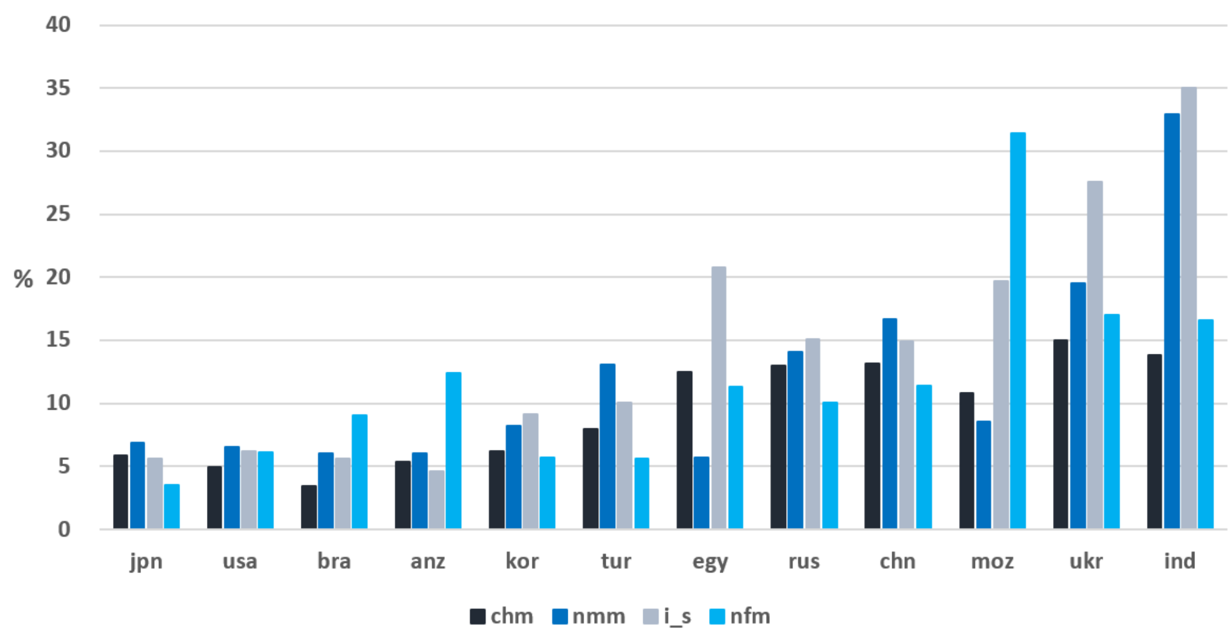
**FIGURE 4** Impact on Exports of CBAM Products to the EU: Scenario 1 (% change from baseline)




**Note:** Figures in the chart indicate the % changes in trade in 2030 due to the CBAM for exporting regions/sectors. Chm, nmm, i_s and nfm refer to chemicals(fertilizers), non-metallic metals(cement), iron and steel, and non-ferrous metals (aluminium), respectively.

**Source:** Authors' calculations based on CGE model

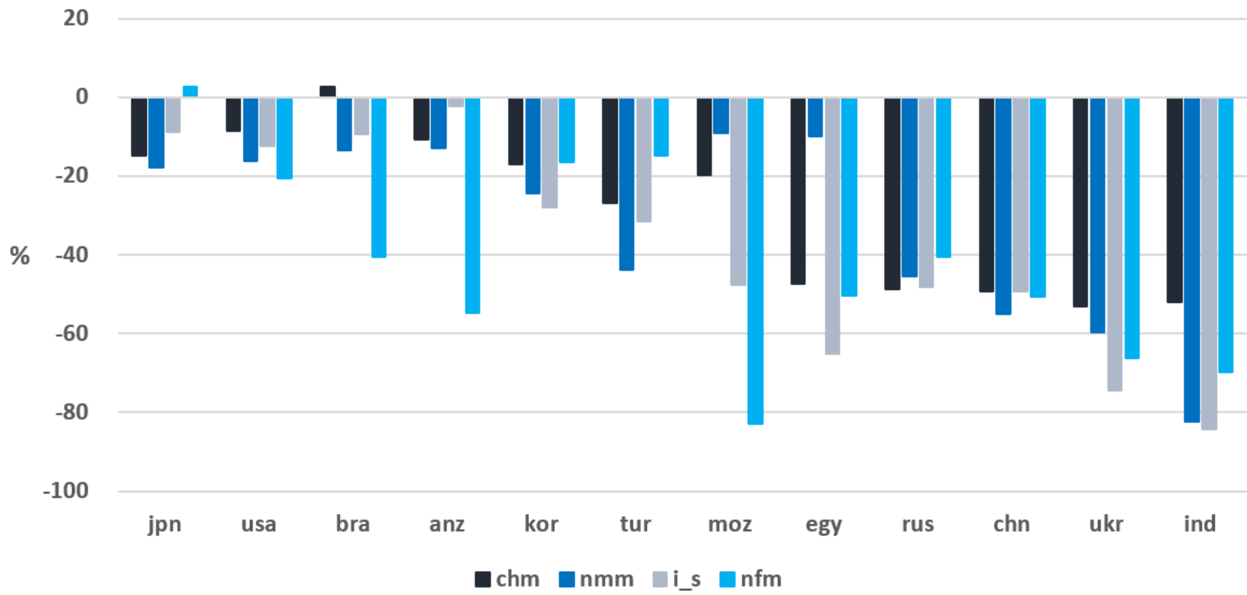
**FIGURE 5** Tariff Equivalents of CBAM: Scenario 2 (ppt change from baseline)




**Note:** Figures in the chart indicate the percentage point increases in tariff equivalent in 2030 due to the CBAM for exporting regions/sectors. Chm, nmm, i_s and nfm refer to chemicals(fertilizers), non-metallic metals(cement), iron and steel, and non-ferrous metals (aluminium), respectively.

**Source:** Authors' calculations based on CGE model

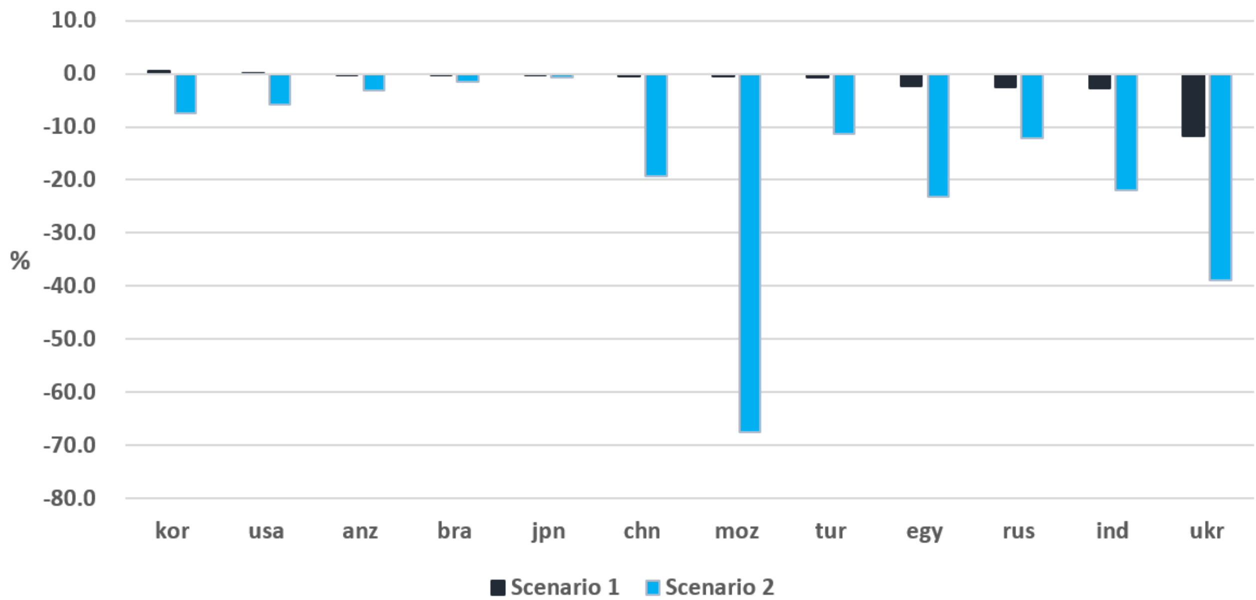
**FIGURE 6** Impact on Exports of CBAM Products to the EU: Scenario 2 (% change from baseline)




**Note:** Figures in the chart indicate the % changes in exports of CBAM products to the EU in 2030 due to the imposition of CBAM for exporting regions/ sectors. Chm, nmm, i_s and nfm refer to chemicals(fertilizers), non-metallic metals(cement), iron and steel, and non-ferrous metals (aluminium), respectively.

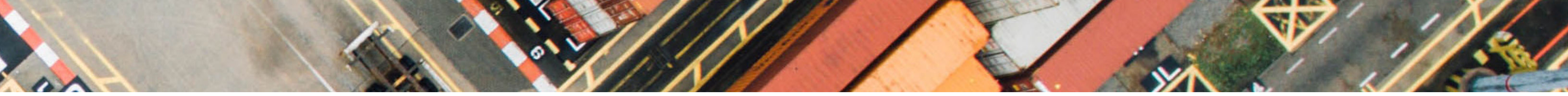
**Source:** Authors' calculations based on CGE model

**FIGURE 7** Impact of CBAM on Total Exports to EU (% change from baseline)




**Note:** Figures in the chart indicate the % changes in total exports to the EU from exporting regions.

**Source:** Authors' calculations based on CGE model



## Impact of CBAM on GDP and Welfare

Under both scenarios, depressed external demand and worsening terms of trade (Figure 8) hurt many developing economies. However, under Scenario 1, the macroeconomic impact on most of these countries is modest. In the case of China, as exports of CBAM products to the EU account for only 0.4 percent of China's total exports, the impact of CBAM on China's GDP is negligible. For economies that are more heavily dependent on exports of these products, such as Russian and Ukraine, the imposition of CBAM could reduce their GDP (in 2030) by 0.2 percent relative to the baseline under Scenario 1, as they are major suppliers of iron and steel, non-ferrous metal, electricity and other carbon-intensive products to the EU.

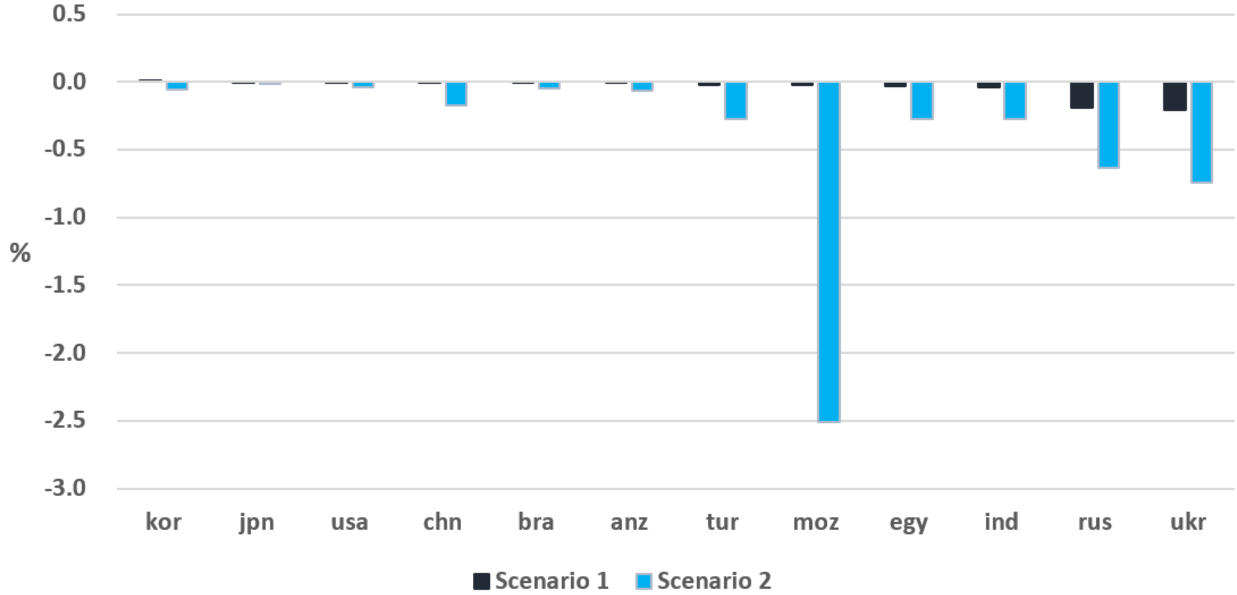
Under Scenario 2, the macroeconomic impacts of CBAM on all jurisdictions are stronger compared with Scenario 1. For example, reduced external demand causes the GDP of Mozambique to shrink by 2.5 percent, the GDP of Russia to shrink by 0.6 percent, and the GDP of India, Egypt and Turkey to shrink by almost 0.3 percent, compared with the baseline. Across different jurisdictions, the magnitudes of the CBAM impact differ greatly. In general, the magnitude of the CBAM impact is positively correlated to the countries' economic dependency and the carbon intensity of their CBAM exports (Figures 1-2). Economies with higher dependency on by CBAM exports and with higher carbon intensity of these exports (due often to lower output value but higher carbon contents) tend to be hurt more than others.

As the CBAM change the relative prices of consumption goods, it also has an impact on households' utility. We use "equivalent variation," denominated in dollars, as a measure of the change in welfare of a country. As shown in Figure 9 and Table 5, in Scenario 1, some developed economies have small net welfare gains, such as Japan and Korea, mainly due to the positive terms of trade effects resulting from the declining prices of carbon-intensive goods. Some developed countries, such as the US and Australia, suffer from some small declines in the terms of trade and welfare losses. But these losses are very small relative to the size of their economies. Most developing countries experience welfare losses.

Under Scenario 2, China, Russia and India incur the greatest welfare losses. This is mostly due to the large size (in USD terms) of total CBAM exports from these countries, although they are a small fraction of their economies. Welfare losses of other developing countries, such as Egypt, Mozambique, Ukraine and Turkey, range between $1 billion to $5 billion, which are significant relative to their GDP levels.

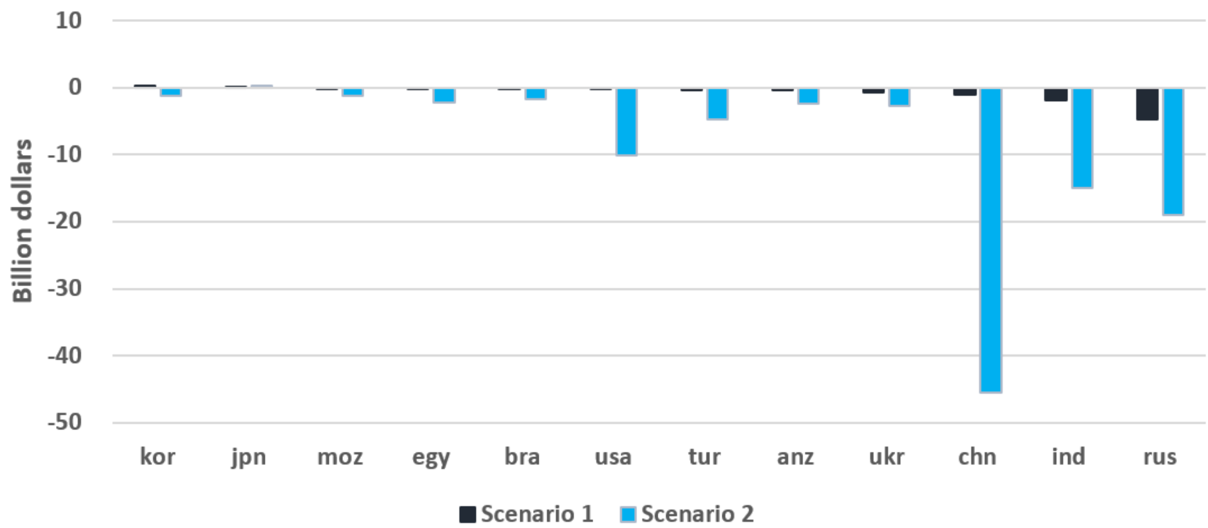
The analysis above indicates that the CBAM will enlarge the gap between developing and developed countries in terms of GDP and welfare. Table 5 shows that under Scenario 1, the welfare gain in selected developed countries (mainly due to change in the EU) amounts to $11 billion, and the welfare loss in selected developing countries amounts to $9 billion, compared with the baseline. Under Scenario 2, the annual welfare gain in developed countries (mainly due to change in the EU) amounts to $141 billion, and the annual welfare loss in developing countries amounts to $106 billion, compared with the baseline.

**FIGURE 8** Impact of CBAM on GDP (% change from baseline, 2030)

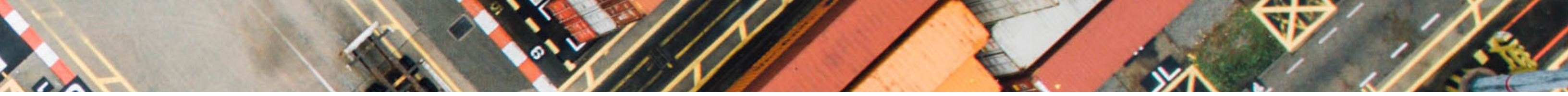



**Note:** Figures in the chart indicate the % changes in the real GDP for exporting regions.
**Source:** Authors' calculations based on CGE model

**FIGURE 9** Change in Welfare from Baseline (in billion USD, 2030)




**Note:** Figures in the chart indicate the dollar amount change (not percentage change) in households' income (equivalent variation) in exporting regions.
**Source:** Authors' calculations based on CGE model



## FURTHER RESEARCH AGENDA

The above simulations results are preliminary, and the outcomes are subject to uncertainties arising from multiple factors. In the following, we discuss a few limitations of the current research and several factors that may reshape the key model parameters. Some of the methodological issues may been addressed by improvement of research tools, and other uncertainties will be clarified as further progress is made in international policy negotiations.

First, our model has only considered two scenarios, and one of them is an "extreme" case. In reality, the EU will likely adopt a scenario that is somewhere in between due to various technical issues (e.g., on data availability and measurement of Scope 3 emissions) regarding the boundary of goods covered by CBAM. For example, it is unclear to what extent the CBAM can cover products outside the coverage of the EU ETS, and whether implicit carbon price (e.g., a carbon tax) could be considered as part of the carbon pricing in calculation of the CBAM "tariffs."

Second, it is difficult to further break down the sectoral classification of the current model and deal with product level (such as aluminium, cement, fertilizers) data due to the current structure the GTAP database. In addition, although our model has been specifically tailored to circumvent the problem of "stuck at zero trade" for small countries, its current version is limited to analyze the impact of CBAM on 24 jurisdictions and does not have the capacity to breakdown into smaller economic units due to limitations of its computational capacity.

Third, our current model only considers the case of the EU imposing a CBAM. It has not discussed the possibility of other advanced economies to follow suit. If all OECD economies decide to adopt the CBAM, its impact on developing countries will certainly be larger than otherwise.

## POLICY IMPLICATIONS

As shown in the simulation results, while the economic spillover effects of the CBAM differ significantly across countries, the following conclusions are clear: developing economies are net losers due to the imposition of the CBAM, and developing economies that heavily rely on carbon-intensive exports will be disproportionally burdened by the spillover effects. While designed with a good intention to accelerate the global transition towards net zero GHG emissions, the CBAM may worsen the income distribution between rich and poor economies, and erode the capacity of some low-income countries to decarbonize their economies.

There are several areas where the IMF and other relevant international organizations can play a role in measuring and addressing the potential negative spillover effects of the CBAM and other climate policies with international implications:

First, assessing and monitoring the impact of a CBAM on balance-of-payments (BOP) positions of vulnerable countries. Countries that are vulnerable to the spillover effects of the CBAM on their exports and GDP will also face a higher risk of balance of payments stress. This is because a deterioration in the terms of trade and a decline in exports often translate

into difficulties in financing current account deficits and a large external debt. As a global institution with the mandate of assisting countries in managing BOP difficulties, the IMF should begin its analytical work on measuring the macro impact of the CBAM including on BOP and financial stability implications, identify emerging risks and vulnerable countries, and incorporate the CBAM risks in the designing of IMF programs for BOP support in the future.

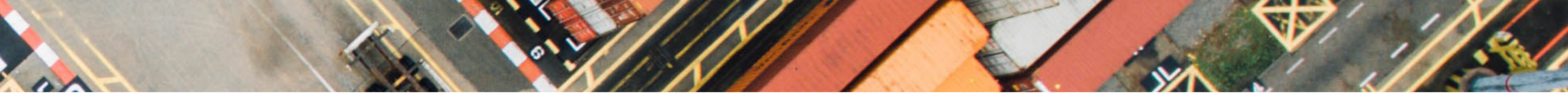
Second, building capacity for vulnerable countries. Vulnerable countries are often lower-income developing countries with low capacity in analysing and forecasting the effects of external shocks on growth, fiscal sustainability and financial stability. One of the major strengths of the IMF is its in-house analytic capacity. The IMF can provide valuable policy advice to the vulnerable member countries on how to analyse and mitigate the spillover risks and improve policy responses.

Third, developing policy options from a perspective of global coordination. Most vulnerable countries are small economies with limited bargaining power in international policy negotiations. The IMF and other international organizations with mandates to promote global economic and financial stability and a just and equitable climate transition should take initiatives in exploring policy options to address the spillover effects of the CBAM, especially those on the most vulnerable developing economies.

One such option worth exploring is an "Equitable Decarbonization Fund" (EDF) funded by CBAM revenues to help developing countries transit toward low carbon economies. By doing so, the tax revenues collected via the CBAM – mostly from developing countries – will be largely returned to developing countries and could be used to boost and green their economies, thus offsetting most of (and even more than offsetting) the negative spill-over effects from the CBAM. Economists could develop a model to show that such an arrangement, if designed and implemented properly, may be welfare enhancing for the world and for developing countries while helping accelerate the global transition to net zero, compared with the current proposal.

How should the EDF spend its money? There are several ways the EDF can deliver a larger (positive) impact on decarbonization and global income distribution than the dollar amount it manages. First, some funds of the EDF could be used as a catalyst, in forms such as de-risking facilities and other blended finance instruments, to crowd in private capital for green and low carbon investments in developing economies, especially those most vulnerable to the CBAM. Second, the EDF could also invest in green and low-carbon technologies with good potential to be applied in developing countries. As developing countries typically have less access to advanced technologies needed to decarbonize the economies, promoting technological developments and lower the costs of accessing these technologies will probably benefit developing countries the most.

In sum, the EDF could become a facility that will contribute positively to the global just/equitable transition process, by allowing developing countries to become net winners rather than losers due to the introduction of the CBAM, and by integrating the capacities from the public sector (i.e., tax policy instruments) and the private sector (i.e., the sustainable finance market).



## REFERENCES


Aguiar, A., Chepeliev, M., Corong, E., Mcdougall, R., & Van Der Mensbrugghe, D. Y. (2019). The GTAP Data Base: Version 10. *Journal of Global Economic Analysis, 4*(1), pp. 1-27.

Böhringer, Christoph, Jared C. Carbone and Thomas F. Rutherford. "Embodied Carbon Tariffs," *ZenTra Working Papers in Transnational Studies* 25 (2014): 1-44.

Condon, Madison and Ada Ignaciuk. "Border Carbon Adjustment and International Trade: A Literature Review," *OECD Trade and Environment Working Papers* 2013/6: 1-32.

Gros, Daniel, Global Welfare Implications of Carbon Border Taxes. *CEPS Working Document* 315(2009): 1-19.

Monjon, Stéphanie and Philippe Quirion. "Addressing leakage in the EU ETS: Border adjustment or output-based allocation?" *Ecological Economics* 70 (2011): 1957-1971.

Qin, Bao, Tang Ling, Zhong Xiangzhang, Qiao Han, and Wang Shouyang "Impacts of border carbon adjustments on China's sectoral emissions: Simulations with a dynamic computable general equilibrium model", *China Economic Review* 24 (2013): 77-94.

Tang, Ling Lu et al. "Carbon-Based Border Tax Adjustments and China's International Trade: Analysis Based on a Dynamic Computable General Equilibrium Model." *Econometric Modeling: International Economics eJournal* 17 (2013).

UNCTAD, "A European Union Carbon Border Adjustment Mechanism: Implications for Developing Countries",2021

Van der Mensbrugghe, Dominique, "The Environmental Impact and Sustainability Applied General Equilibrium (ENVISAGE) Model," 2019

Weisbach, David A., Joshua Elliott, Ian Foster, Sam Kortum & Todd Munson, "Unilateral Carbon Taxes, Border Tax Adjustments, and Carbon Leakage," *Theoretical Inquiries In Law* 14 (2013): 207-244.

Zachmann, Georg and Ben McWilliams, "A European carbon border tax: much pain, little gain", Policy Contribution 5 (2020): 1-19.

Zhai, Fan, "Armington Meets Melitz: Introducing Firm Heterogeneity in a Global CGE Model of Trade", *Journal of Economic Integration* 23(3), September 2008

Zhai, Fan, "China's belt and road initiative: A preliminary quantitative assessment", *Journal of Asian Economics*, 55 (2018) 84–92

# APPENDIX TABLES

**TABLE 1** Tariff Equivalents (in %) on CBAM Products

| Countries/Regions | Scenario 1 | | | | Scenario 2 | | | |
|---|---|---|---|---|---|---|---|---|
| | Chemicals | non-metallic metals | iron and steel | non-ferrous metals | Chemicals | non-metallic metals | iron and steel | non-ferrous metals |
| **Selected Advanced Economies** | | | | | | | | |
| Australia and New Zealand (anz) | 1.4 | 2.1 | 1.0 | 2.6 | 5.4 | 6.1 | 4.6 | 12.4 |
| Japan (jpn) | 1.7 | 3.6 | 0.9 | 0.3 | 5.9 | 6.9 | 5.6 | 3.5 |
| Canada (can) | 1.2 | 2.8 | 2.6 | 0.4 | 6.1 | 6.4 | 7.7 | 6.0 |
| United States of America (usa) | 0.9 | 2.7 | 1.6 | 0.5 | 5.0 | 6.6 | 6.2 | 6.1 |
| South Korea (kor) | 0.5 | 3.4 | 1.4 | 0.2 | 6.2 | 8.2 | 9.2 | 5.7 |
| **BRICs** | | | | | | | | |
| China (chn) | 2.1 | 5.7 | 3.3 | 0.7 | 13.2 | 16.6 | 14.9 | 11.4 |
| India (ind) | 2.6 | 18.5 | 15.4 | 1.7 | 13.8 | 32.9 | 35.1 | 16.6 |
| Brazil (bra) | 0.8 | 3.8 | 2.7 | 4.4 | 3.4 | 6.0 | 5.6 | 9.1 |
| Russia (rus) | 3.5 | 5.9 | 4.1 | 0.1 | 13.0 | 14.1 | 15.1 | 10.0 |
| South Africa (zaf) | 1.2 | 10.2 | 6.5 | 2.1 | 15.2 | 23.4 | 18.8 | 15.1 |
| **Selected Developing Economies** | | | | | | | | |
| Kazakhstan (kaz) | 3.6 | 6.5 | 17.3 | 4.2 | 17.3 | 14.0 | 48.7 | 10.8 |
| Ukraine (ukr) | 0.8 | 7.2 | 10.4 | 2.7 | 15.0 | 19.6 | 27.6 | 17.1 |
| Turkey (tur) | 2.0 | 6.3 | 1.8 | 0.7 | 8.0 | 13.1 | 10.1 | 5.6 |
| Mexico (mex) | 2.2 | 5.4 | 3.2 | 0.3 | 7.8 | 10.8 | 10.1 | 5.4 |
| Egypt (egy) | 3.4 | 2.3 | 6.4 | 1.5 | 12.5 | 5.7 | 20.8 | 11.3 |
| Mozambique (moz) | 1.3 | 2.1 | 0.0 | 0.4 | 10.8 | 8.6 | 19.7 | 31.4 |
| **Selected Regions** | | | | | | | | |
| Association of South East Asian Nations (ASEAN) | 1.6 | 9.6 | 3.0 | 1.8 | 7.0 | 17.1 | 14.2 | 7.8 |
| Latin American Countries (lac) | 2.4 | 3.4 | 5.1 | 0.6 | 6.2 | 6.2 | 12.9 | 4.2 |
| Sub-saharan Africa (SSA) | 1.9 | 4.4 | 4.1 | 0.2 | 5.9 | 7.5 | 14.4 | 3.4 |
| Middle East & North Africa (MENA) | 5.2 | 5.5 | 3.7 | 3.0 | 10.1 | 8.7 | 9.6 | 12.2 |
| Least developed country (LDC) | 3.0 | 8.7 | 2.4 | 0.3 | 10.9 | 15.5 | 11.9 | 6.5 |
| Rest of the world (row) | 13.5 | 5.5 | 3.3 | 0.8 | 36.1 | 12.8 | 15.1 | 7.5 |

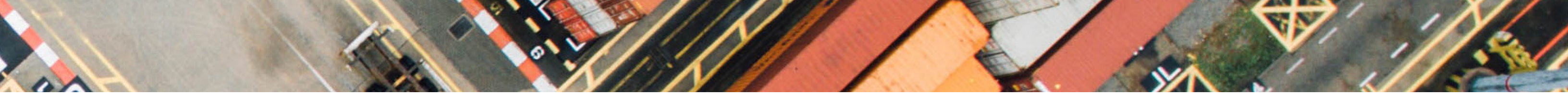


**TABLE 2** Impact on Exports of CBAM Products to the EU (% from baseline, 2030)

| Countries/Regions | Scenario 1 | | | | Scenario 2 | | | |
|---|---|---|---|---|---|---|---|---|
| | Chemicals | non-metallic metals | iron and steel | non-ferrous metals | Chemicals | non-metallic metals | iron and steel | non-ferrous metals |
| **Selected Advanced Economies** | | | | | | | | |
| Australia and New Zealand (anz) | -5.0 | -6.1 | 0.8 | -20.4 | -10.7 | -13.0 | -2.4 | -54.9 |
| Japan (jpn) | -6.9 | -15.0 | 1.5 | 0.3 | -14.7 | -18.0 | -8.9 | 2.7 |
| Canada (can) | -3.2 | -10.6 | -10.0 | -1.2 | -15.9 | -15.4 | -20.9 | -19.6 |
| United States of America (usa) | -0.6 | -9.8 | -3.3 | -2.2 | -8.6 | -16.3 | -12.4 | -20.5 |
| South Korea (kor) | 2.1 | -14.2 | -1.8 | 1.1 | -17.0 | -24.4 | -27.9 | -16.4 |
| **BRICs** | | | | | | | | |
| China (chn) | -9.0 | -24.7 | -13.5 | -3.8 | -49.3 | -55.0 | -49.4 | -50.5 |
| India (ind) | -12.8 | -65.2 | -58.5 | -11.8 | -52.1 | -82.4 | -84.2 | -69.7 |
| Brazil (bra) | -0.4 | -16.8 | -10.5 | -34.2 | 2.7 | -13.6 | -9.4 | -40.5 |
| Russia (rus) | -18.3 | -25.9 | -17.3 | 4.4 | -48.6 | -45.5 | -48.3 | -40.5 |
| South Africa (zaf) | -8.7 | -44.3 | -30.5 | -16.0 | -54.2 | -67.8 | -58.2 | -62.0 |
| **Selected Developing Economies** | | | | | | | | |
| Kazakhstan (kaz) | -19.2 | -29.5 | -63.9 | -30.7 | -56.9 | -41.9 | -90.8 | -38.2 |
| Ukraine (ukr) | 2.3 | -30.1 | -43.4 | -17.5 | -53.1 | -59.7 | -74.4 | -66.3 |
| Turkey (tur) | -8.5 | -28.2 | -4.1 | -3.8 | -27.0 | -43.9 | -31.6 | -15.0 |
| Mexico (mex) | -10.4 | -25.7 | -13.7 | -0.4 | -26.4 | -36.5 | -32.5 | -14.8 |
| Egypt (egy) | -18.3 | -7.0 | -29.2 | -10.9 | -47.3 | -10.0 | -65.1 | -50.4 |
| Mozambique (moz) | -3.8 | -6.0 | 8.9 | 0.7 | -99.9 | -78.3 | -98.6 | 70.3 |
| **Selected Regions** | | | | | | | | |
| Association of South East Asian Nations (ASEAN) | -6.1 | -41.9 | -12.3 | -13.4 | -21.4 | -56.6 | -48.1 | -31.0 |
| Latin American Countries (lac) | -12.3 | -14.7 | -24.1 | -2.7 | -16.4 | -14.2 | -43.6 | -3.7 |
| Sub-saharan Africa (SSA) | -8.9 | -19.9 | -18.8 | 0.5 | -15.4 | -22.0 | -49.5 | 2.8 |
| Middle East & North Africa (MENA) | | | | | | | | |
| Least developed country (LDC) | -29.0 | -26.2 | -16.8 | -24.5 | -37.4 | -25.8 | -28.8 | -54.3 |
| Rest of the world (row) | -15.8 | -38.5 | -8.5 | 0.4 | -42.4 | -53.8 | -41.6 | -25.0 |


**TABLE 3** Impact on Total Exports to the EU (% from baseline, 2030)

| Countries/Regions | Scenario 1 | Scenario 2 |
|---|---|---|
| **Selected Advanced Economies** | | |
| Australia and New Zealand (anz) | 0.0 | –3.1 |
| Japan (jpn) | –0.4 | –0.7 |
| Canada (can) | –0.1 | –7.1 |
| United States of America (usa) | 0.2 | –5.9 |
| South Korea (kor) | 0.4 | –7.5 |
| **BRICs** | | |
| China (chn) | –0.4 | –19.2 |
| India (ind) | –2.7 | –21.9 |
| Brazil (bra) | –0.2 | –1.5 |
| Russia (rus) | –2.6 | –12.1 |
| South Africa (zaf) | –4.0 | –34.9 |
| **Selected Developing Economies** | | |
| Kazakhstan (kaz) | –1.4 | –46.8 |
| Ukraine (ukr) | –11.8 | –38.9 |
| Turkey (tur) | –0.7 | –11.3 |
| Mexico (mex) | –1.0 | –6.9 |
| Egypt (egy) | –2.4 | –23.2 |
| Mozambique (moz) | –0.5 | –67.4 |
| **Selected Regions** | | |
| Association of South East Asian Nations (ASEAN) | –0.1 | –13.0 |
| Latin American Countries (lac) | –1.3 | –7.0 |
| Sub-saharan Africa (SSA) | –0.2 | 5.2 |
| Middle East & North Africa (MENA) | –1.4 | –2.2 |
| Least developed country (LDC) | 0.0 | –2.9 |
| Rest of the world (row) | –7.4 | –33.0 |

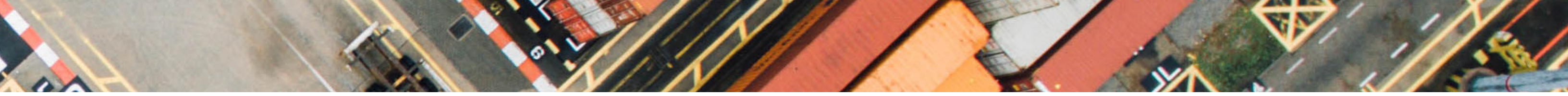


**TABLE 4** Impact on GDP (% from baseline, 2030)

| Countries/Regions | Scenario 1 | Scenario 2 |
|---|---|---|
| **Selected Advanced Economies** | | |
| Australia and New Zealand (anz) | 0.0 | -3.1 |
| Japan (jpn) | -0.4 | -0.7 |
| Canada (can) | -0.1 | -7.1 |
| United States of America (usa) | 0.2 | -5.9 |
| South Korea (kor) | 0.4 | -7.5 |
| **BRICs** | | |
| China (chn) | -0.4 | -19.2 |
| India (ind) | -2.7 | -21.9 |
| Brazil (bra) | -0.2 | -1.5 |
| Russia (rus) | -2.6 | -12.1 |
| South Africa (zaf) | -4.0 | -34.9 |
| **Selected Developing Economies** | | |
| Kazakhstan (kaz) | -1.4 | -46.8 |
| Ukraine (ukr) | -11.8 | -38.9 |
| Turkey (tur) | -0.7 | -11.3 |
| Mexico (mex) | -1.0 | -6.9 |
| Egypt (egy) | -2.4 | -23.2 |
| Mozambique (moz) | -0.5 | -67.4 |
| **Selected Regions** | | |
| Association of South East Asian Nations (ASEAN) | -0.1 | -13.0 |
| Latin American Countries (lac) | -1.3 | -7.0 |
| Sub-saharan Africa (SSA) | -0.2 | 5.2 |
| Middle East & North Africa (MENA) | -1.4 | -2.2 |
| Least developed country (LDC) | 0.0 | -2.9 |
| Rest of the world (row) | -7.4 | -33.0 |


**TABLE 5** Change in Welfare from Baseline (in USD bn, 2030)

| Countries/Regions | Scenario 1 | Scenario 2 |
|---|---|---|
| **Selected Advanced Economies** | | |
| Australia and New Zealand (anz) | -0.3 | -2.0 |
| Japan (jpn) | 0.2 | 0.0 |
| Canada (can) | -0.2 | -2.0 |
| United States of America (usa) | -0.2 | -10.0 |
| South Korea (kor) | 0.3 | -1.0 |
| EU (eur) | 10.7 | 146 |
| UK, Switzerland and Norway (usn) | 0.7 | 10 |
| **BRICs** | | |
| China (chn) | -1.1 | -46.0 |
| India (ind) | -1.8 | -15.0 |
| Brazil (bra) | -0.2 | -2.0 |
| Russia (rus) | -4.7 | -19.0 |
| South Africa (zaf) | -0.2 | -2.0 |
| **Selected Developing Economies** | | |
| Kazakhstan (kaz) | -0.2 | -9.0 |
| Ukraine (ukr) | -0.7 | -3.0 |
| Turkey (tur) | -0.3 | -5.0 |
| Mexico (mex) | -0.3 | -2.0 |
| Egypt (egy) | -0.2 | -2.0 |
| Mozambique (moz) | 0.0 | -1.0 |
| **Selected Regions** | | |
| Association of South East Asian Nations (ASEAN) | -0.5 | -12.0 |
| Latin American Countries (lac) | -0.7 | -4.0 |
| Sub-saharan Africa (SSA) | -0.5 | -2.0 |
| Middle East & North Africa (MENA) | -2.7 | -14.0 |
| Least developed country (LDC) | 0.0 | 0.0 |
| Rest of the world (row) | -0.4 | -2.0 |