

Energy Efficiency of CO₂ Emission Nexus in the EU: Assessing the Effect of Carbon Border Adjustment Mechanism on CO₂ Emission Reduction Using the GTAP-E Model

Abstract

Carbon leakage remains a matter of concern in environmental and climate policy formulation. One policy option to address carbon leakage is carbon tax which has remained contentious. For instance, the EU's intention to introduce a carbon tax through the Carbon Border Adjustment Mechanism (EU-CBAM) has raised serious concerns among the EU's trading partners, among them the least developing countries (LDCs) and middle-income countries (MICs). This study aims to assess the impact of the EU-CBAM on the EU's trading partners by income, focusing on the LDCs and the MICs using the GTAP-E: an Energy-Environment model and the current GTAP database, version 10.1, with the base year of 2014. For the relevance of this research, we map the GTAP database into data for 24 regions in 24 sectors. The business as usual (BAU) scenario involves model adjustments to 2021 using macroeconomic variables, which include GDP, population, skilled labor, unskilled labor, and capital stock. The study implements two policy scenarios using the ad valorem carbon tax equivalents estimated using the input-output (I-O) model. The novelty of our study is in the assessment of the impact of the EU-CBAM on efficiency in energy production processes, the evaluation of carbon embedded in exports to the EU27, the estimation of ad valorem equivalents of CBAM (carbon tax), and the economy-wide impact of CBAM on the EU27 and its trading partners classified according to income level.

Keywords: Carbon Border Adjustment Mechanism, Carbon Leakage, Energy Efficiency, EU, GTAP-E Model, Least-Developing Countries, Middle-Income Countries.

JEL Classifications: C68, C83 D31, O15

I. Introduction

The Intention of the European Union (EU27) to impose a carbon tax on all imports entering the EU market has raised serious concerns among all its trading partners that, include the least developing countries (LDCs), the middle-income countries (MICs), and even the developed countries such as the US, the UK, Korea, China, and Japan (Durant et al., 2021; Acar, Aşıcı, and Yeldan, 2022).

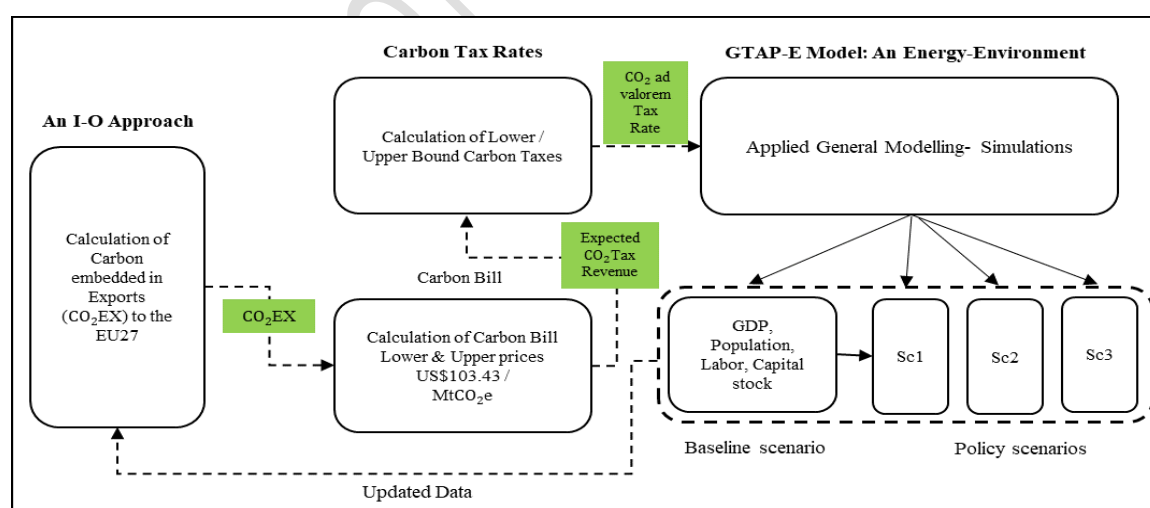
The plan to decarbonize the European Union economies to net zero by 2050 through the European Green Deal (EGD) employs the carbon border adjustment (CBA) mechanism. The key aims of the CBAM are to curb carbon emission leakage and safeguard the competitiveness of domestic firms in the local and international markets by leveling the decarbonizing costs of production processes for European firms with those of trading partners. The (EU-CBAM) aims to reduce the risk of carbon leakage and the adverse impact on the EU's trade competitiveness due to the expected spike in production costs within the EU27 trading bloc and its trading partners (Böhringer et al., 2010).

Since the CBAM is tied to the EU emission trading system (ETS), with a volatile carbon pricing system, the CBAM is likely to affect production costs faced by firms in the EU market and thus affect their competitiveness in the domestic and international markets. In turn, this would force firms in the EU economy to restructure their business to remain competitive. Available literature indicates that the nature of each industry in terms of mobility and the intensity of foreign trade determine the response mechanism to the increase in production costs. For instance, some sectors (such as transport) cannot relocate to countries with fewer regulations on carbon emissions and hence have to bear extra costs due to new regulations. On the other hand, industries dependent on imported inputs will likely relocate production operations to regions with fewer regulations on greenhouse emissions.

The European Parliament, in support of the control of carbon emissions leakage, agreed (on March 10, 2022) through a resolution on introducing a CBAM compatible with WTO and the EU's FTA's rules and regulations of non-discriminatory and free trade (European Parliament, 2021a). Most importantly, the adopted resolution suggests linking the CBAM to the European Union Emissions Trading System (ETS) while leveling decarbonizing costs of production processes for European industries with those of trading partners. With such a framework, no incentive to shift production processes to regions with less ambitious emission reduction targets (European Parliament, 2021b). Implementing the CBAM involves applying a carbon tax to imported goods from industries with the potential risk of carbon leakage, especially from countries with lower regulatory mechanisms on carbon emissions than the European Union. This new regulatory mechanism burden would be similar to costs imposed on domestic producers in the European Union under its ETS. To avoid double charges no extra charges on imports from countries that impose similar environmental policies (European Parliament, 2021b).

In order to assess the economy-wide impact and efficiency on energy production of the EU-CBAM of different economies based on income level, we employ two models. First, we employ the input-output model (Chepeliev, 2021). to estimate the emission embedded in exports (CO₂EEXs) to the EU27 by sector and utilize the estimated CO₂EEXs values and the EU-ETS carbon prices to calculate the ad valorem carbon tax equivalent. We use the estimated carbon tax values as policy inputs. Finally, using the GTAP-E model: an extension of a multi-region, multi-sector standard GTAP model called the GTAP-E model (Burniaux & Truong, 2002; Hertel & Tsigas, 1997; McDougall & Golub, 2009) and GTAP database version 10 with the base year of 2014 (Aguiar et al., 2019) to simulate the impact of the EU-CBAM using the calculated ad valorem carbon tax equivalent on different economies differentiated by the level of income. Figure 1 details the model schema applied in this study.

Figure 5. Applied CGE Model Schema



Source: Authors' drawing

A significant number of empirical studies evaluating the potential impact of a carbon tax have been conducted (Acar, Aşıcı, and Yeldan 2022; Chepeliev 2021; Durant et al. 2021;). These studies have consistently found that CBAM has a potential economic impact on the EU and its trading partners. However, available studies

accounting for the impact of the EU-CBAM on different economic groups based on income level are scanty and not comprehensive. Furthermore, this study also seeks to quantify the contribution of the EU-CBAM on efficiency in energy production, especially in low-income countries.

Most importantly, this study focuses on assessing the economy-wide effects of the EU-CBAM on the least-developed countries (LDCs) (Perdana & Vielle, 2022), the lower-middle-income countries (LMICs), and the upper-middle-income countries (UMICs) by addressing two main issues: First, by examining the economy-wide impacts of the CBAM on GDP, welfare, carbon emissions, trade, and domestic output in the European Union and its main trading partners. Second, evaluating the potential effects of CBAM on efficiency in energy production, especially in developing countries.

This study is structured as follows: After the introduction, Section II provides a brief overview of the CBAM, including its objectives. Section III reviews the available literature, and Section IV describes the applied method and data. Simulation results are discussed in Section V, while Section VI presents the discussion and conclusion remarks.

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