

CO2 Emissions: analysis for Brazilian Economy

Topic: Input-Output Analysis: Sustainable Production and Consumption policies (12)

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This study evaluates the economic impacts of reducing greenhouse gas (GHG) emissions in the Brazilian economy by employing an integrated input-output linear programming model for the years 2012 and 2018. The study seeks to answer the following questions: What is the economic impact (Gross Value of Production – GVP, employment) resulting from the reduction of CO2 emissions? Is it possible to reduce CO2 without significantly compromising employment? Which sectors contribute the most to CO2 reduction at the lowest economic cost? To address these questions, an optimization model was developed with the CO2 emission target as its primary constraint.

The database for the temporal and systemic assessment of emissions within the Brazilian economy consists of the input-output matrices developed by the Regional and Urban Economics Lab of the Federal University of S  o Paulo (NEREUS). These matrices were constructed based on data from the System of National Accounts (SNA), following the methodology proposed by Guilhoto and Sesso Filho (2005, 2010). Regarding Brazil's CO2 emissions matrix, data were primarily sourced from the SEEG Brasil website, which serves as the main platform for consulting annual greenhouse gas emission estimates across all sectors of the economy.

The literature features several studies that have employed various techniques to measure the economic impact of GHG emission mitigation at both regional and sectoral levels. The most frequently utilized methods are input-output (I-O) analysis [Carvalho (2013); Silva Freitas et al. (2016); Liu and Wang (2015)], computable general equilibrium (CGE) models [Allan et al. (2014); Chen et al. (2013); Gurgel and Paltsev (2014); Magalh  es and Domingues (2013); Orlov and Grethe (2012)], and the integration of linear programming (LP) with I-O [Crist  bal (2010); Hristu-Varsakelis et al. (2010); Hristu-Varsakelis et al. (2012)].

The integration of IO-LP models is a widely used tool for assessing the economic impacts of climate policy. By employing an integrated model, we explicitly incorporate the constraint side (e.g., economic and environmental constraints) into the framework. This feature, along with the model's simplicity regarding data requirements (Rose and Casler, 1996), assumptions, and operational capabilities, can be considered advantages of our approach.

Several emission scenarios were constructed, taking into account sectoral composition and available production technology. The results demonstrate that the high level of emissions in sectors such as Livestock, combined with their economic relevance, causes a significant impact across the entire production chain. Across all scenarios, Livestock and the Wholesale and Retail Trade sectors were consistently the most affected, suffering the greatest losses in Gross Value of Production (GVP). Our findings suggest that distinct sectoral targets, combined with policies such as taxation or the granting of emission allowances, are crucial for balancing environmental benefits with economic losses. Such policies can create private incentives for emission mitigation, enabling a fairer transition that is adapted to the specificities of each sector.