Climate hazards economic impact analysis using a Bio-MRSUT framework

Topic: Economics of Food Systems - II
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Regardless of its origin, causes and potential evolution, it seems clear that climate change is a phenomenon that is already leaving important consequences in the form of droughts, floods, increase in average temperatures, and other adverse phenomena, which translate directly in economic consequences: crop losses, destruction of infrastructure, forest fires, ... But these economic consequences and impacts should not be assessed solely from their direct quantification, but rather it is necessary to consider the indirect and induced effects that are produced through the circular flow of income. In this sense, this paper propose an analysis of the economic impact of biophysical shocks due to climate extremes requires a multi-sectoral framework that quantifies the interrelationships between production, demand and supply.

To measure these effects, the use of multisector models, of the Input-output type, is particularly appropriate, but not only the classic one based on linear multipliers. In this work, an alternative approach is presented based on an improvement of the modelling of disasters proposed by Faturay et al. (2020) and Huang et al. (2022), who use novel developments for the analysis of disasters with input-output models. This model tries to offer an alternative to the assumptions of the classic Leontief model, especially about the possibility of a reallocation of resources and production, both between the countries and regions of the EU, as well as with the Rest of the World. This model uses the technical coefficient matrix, but not its inverse and a maximisation of the joint output (or linked variables) of related zones or regions is proposed in the event of a catastrophic external shock, allowing the transfer of production between zones (regions and/or countries) and taking as the only restriction the maintenance of the supply as an input of the goods affected by the disaster. However, this optimisation algorithm generates a much more limited process of reallocation of output between regions than expected and that makes it hypersensitive to situations of strong initial shocks in production, so the model has been improved with the introduction of new restrictions and the relaxation of others, now allowing a flexible, more realistic reassignment that provides more coherent and feasible results.

Anyway, to provide a more comprehensive view, the traditional impact analysis model based on Input-Output models has been also applied, using the multiplier matrices resulting from the classic Leontief inverse, obtaining the so-called backward linkages of the initial direct effects of a shock (in this case, on the production/disposal of bio-economy output caused by climate hazards), to reflect the effects in the whole economy.

For this analysis, it has been necessary the elaboration of a new database, called Bio-MRSUT (Bio-economic Multi-regional Supply-Use Tables). This database, with coverage for the 28 MS of the EU is derived from EXIOBASE (Stadler et al., 2018), subsequently completed with additional information on certain bioeconomy sectors (agriculture, livestock, and biofuels) using the 2010 and 2015 BioSAMs (Mainar-CausapÃ© et al., 2021) carried out by the Joint Research Centre (JRC). The Bio-MRSUT multiregional frameworks comprise, with reference to the year 2015, a total of 78 activities (44 of Bioeconomy) and 78 goods and services (44 of them bio-economics), for the 28 EU countries (including the United Kingdom) and the Rest of the World, (as well as the interrelationships and bilateral exchanges between all these territories). In addition, they contain the breakdown of final demand and value added, as well as taxes on activities and products and imports by origin (the resulting data matrix contains 4,529 rows and 4,669 columns). Also, a regionalised base, at NUTS 2

level, for Germany (38 regions), Austria (9 regions) and Spain (19 regions), has been estimated.

The characteristics of this database, which contains interrelationships between the 28 MS of the EU 2015 and has a complete disaggregation of agricultural and bio-based non-agricultural sectors and goods, makes it possible to simulate the effects that shocks, due to the climate hazards, have in certain sectors or commodities, allowing a first quantification, through the analysis of the damage attributable to climate change.