A dynamic CGE GTAP-type model to assess linkages between trade and climate change policies

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Abstract

The environmental ambition of the Green Deal will not be achieved by the European Union acting alone since the strictly interconnected global exchanges of good and services, knowledge and human capital are a key source of spillovers affecting policy effectiveness. More importantly, the drivers of climate change are global and are not limited by national borders. Acting alone in the fight to climate change is not only almost un-effective in environmental terms, given the increasing reduction of the EU relative contribution to global emissions, but it might also bring to substantial negative effects on European firms and citizens since ambitious abatement targets might be extremely expensive for the economic system (Antimiani et al., 2013; Corradini et al., 2018). On the contrary, cooperative solutions seem to be effective and welfare improving for the global society, especially if economic costs provoked by climatic damages are fully included in cost-benefit analysis and policy impact evaluation (Costantini et al., 2018).

In this context, it is necessary to develop tools that encompass multiple aspects of the future development of economic and environmental issues. In this paper we present a dynamic CGE model running in RunDynam which allows simulating scenarios jointly including key challenging features such as climate change, climate mitigation and adaptation policies, energy system changes, clean energy technology patterns and trade policies impacts. The model draws on three databases (GTAP-dyn, GTAP-E and GTAP-Power, updated at version 10 related to the year 2014) and features endogenous technological change for clean energies and energy efficiency as well as economic evaluation of climatic damage according to Costantini et al. (2018).

The model is complemented by three elements.

First, the information on emissions related to non-combustion processes associated with final goods consumption, as provided in the original GTAP nonCO2 database is converted into emissions associated with input consumption into production processes. This allows to introduce into the model two novelties: i) to treat all GHG emissions in the same way under the specific abatement policy under scrutiny involving key sectors in climate negotiations as agriculture; ii) to include all GHG in the calibration of the BAU and the policy scenarios thus obtaining a full correspondence between emission flows directly modelled into RunDynam and emission stocks in part per million (PPM) as required by climate models for projecting the relative damage. These two novelties will ensure full consistency of the CGE model with an Integrated Assessment Model (IAM) structure, given that the physical aspects of climate change are embedded into the CGE.

Second, based on the Green Technology database developed by INGENIO, two aspects associated to the development and deployment of clean energy technologies can be integrated into the CGE structure: i) information on diffusion and adoption of clean energy technologies will be embedded into the model structure via changes into behavioural parameters both in production processes (being represented for instance with changes into input productivity or input substitution elasticity) and in consumption patterns (represented, for instance, with different consumption basket compositions as already tested for the impact of the ageing society in Costantini and Sforna, 2019), ii) changes in the production structure of those countries investing in clean energy technologies will be also transformed into impacts in terms of labour market composition associated to job creation (green jobs) and destruction (input-biased technical change) that are of crucial relevance for the EU debate (EU, 2019).

Third, the model is enriched by the module developed by Antimiani et al. (2018) to compute the decomposition of the value added along the supply chain with the help of WIOD and MRIO databases

to assess the linkages between trade policies and CO2 emissions accounting for the carbon embedded in traded intermediate inputs. The model structure is enriched by the GTAP-VA module that can work as an external satellite computing activity independently from the scenario under evaluation. Two examples of scenario analysis are:
As an example of scenario analysis capturing all these aspects, we present some preliminary results dealing with: i) emissions reallocation along the supply chains (e.g., following production process spanned across several countries) differentiating across sectors and countries to assess effectiveness of different policy designs associated to the value chain structure; ii) sectors/countries which are more influenced by the introduction of clean energy technologies in the energy sector.

Keywords: international trade; climate change; mitigation policy; trade policy; economic competitiveness

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