A REGIONAL INTEGRATED ASSESSMENT MODEL OF CLIMATE AND THE ECONOMY: WHICH ROLE FOR THE MEDITERRANEAN REGION?

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Overview

Integrated Assessment Models (IAMs) are a tool able to study the effect of human economic activity on natural earth systems, both at global and regional level. They support researchers, scientists and policymakers in the evaluation of the damage due to climate change in both economic and environmental terms. In such a framework, we update the Regional Dynamic Integrated model of Climate and the Economy (RICE) up to 2020, following Nordhaus and Boyer (2000) (RICE-99, hereafter) as well as Nordhaus and Yang (1996), to consider the impact of different climate policy scenarios on the main socio-economic variables (e.g. output, consumption, population) as well as on the evolution of CO2 emissions. Furthermore, we extend the original regionalization framework (i.e. USA, China, Europe, Russia and Eastern Europe, Other High-Income countries, Middle Income countries and Low Income countries) to include an additional Mediterranean region (MED region, hereafter),[1] which has been identified as a ”hot spot” of climate change in literature (Galeotti 2020; Tuel and Eltahir, 2020). In doing so, we exploit the regional heterogeneity to discuss the possible regional climate impact and economic damages, with the aim to answer the following research questions: (i) what are the economic and climate effects of the current climate targets on the regions included in RICE-MED? (ii) how the increase in temperature affects the MED region in terms of production?

Methods

Integrated Assesment Models (IAMs) combine scientific and socio-economic aspects of climate change, assessing related policy options (Anna and Fulvio, 2019). Following the RICE-99 framweork, the introduction of the MED region gives the opportunity to analyze the impacts of a rise in the temperature and sea level of the Mediterranean see on its overlooking countries, which differ significantly in both their institutional frameworks and production systems, hence in their ability to react to systemic shocks. In such a framework, we provide our formulation of the analytical initial condition of the model, based on the economic equilibrium in each country/region, as well as a specific disaggregation of the energy sector respect to different energy sources. Once model is feed with these updated data, each region is solved showing the projections of some key variables, such as consumption, output and emissions. As a second step, the regional economic module is solved including a climate module where carbon concentration are seen as ”negative capital” and reductions in emissions lower the quantity of it. The economic and the climate module are linked through the damages generated by increases in temperature, which directly impact aggregate output.

Results

Thanks to the updated calibration of the model, with a population and temperature dynamics in line with IIASA SSP2 RCP 4.55[2], we analyze alternative future scenarios. Specifically, we focus the three scenarios: Business-As-Usual (BAU), Optimal (OPT) and Climate Targets (CT). The first assumes no changes in the climate policy with respect to the 2020 levels and shows the consequences of inaction. In the OPT one, the social welfare is maximized, accounting for the impacts of climate change on output and therefore consumption. In addition to that, it identifies the optimal climate policy balancing the present value of abatement costs and the present value of benefits

[1] The MED region is composed by the following countries: Albania, Algeria, Croatia, Cyprus, Egypt, Ethiopia, France, Greece, Israel, Italy, Lebanon, Libya, Malta, Monte negro, Marocco, Spain, Sudan, Syria, Tunisia,Turkey

[2] Fricko et al. (2017) describes the Shared Socioeconomic Pathway 2, as the middle-of-the-road scenario for the 21st century. ”The world follows a path in which social, economic, and technological trends do not shift markedly from historical patterns. Development and income growth proceed unevenly, with some countries making relatively good progress while others fall short of expectations. Most economies are politically stable. Globally connected markets function imperfectly. Global and national institutions work toward but make slow progress in achieving sustainable development goals, including improved living conditions and access to education, safe water, and health care”. In such a framework the Representative Concentration Pathways (RCP) forcing target is 4.5 W/m2.

associated with climate change mitigation. This scenario serves as a benchmark to compare the effect of other policies. Finally, the CT scenario sets a constraint, requiring temperature not to exceed a certain level, representing climate targets. Such scenario represents the level of coordination among countries, as decided in the Paris agreement (2015) or in the Glasgow Climate Change Conference (UNFCCC, 2021).

Conclusions

The RICE-MED model allows to account not only for the global climate change externality, but also for the regional effects and offer new estimates regarding the carbon price, which summarizes the social costs of environmental policies, as well as the expected damages due to climate change. The outcomes of the model can also support decision makers in the understanding on how Mediterranean countries could implement policies to mitigate and adapt to climate change effects. In addition to that, the structure of the RICE-MED model allows also to account for the role of energy as a production factor. Indeed, the possibility to observe in detail the disaggregation of the energy sector as part of the initial conditions, can provide further insights on the relation between the energy markets, the economy and related climate implications. This feature is a crucial element of the original RICE-99 and serves to model the economies in a more realistic way. The novelty of the model we propose consists in updating the historical RICE-99 model, trying to better capture the misalignment of growth paths from initial conditions. The resetting of parameters should allow for the incorporation of global economic shocks that have occurred over the years and that could not be predicted in the original version of the model. This could lead to accurate forecasts that are more in line with the latest available data. A second new feature is the greater ability of the new model to capture the heterogeneity of the Mediterranean countries, which are characterized by different characteristics and levels of resilience to systemic shocks.

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