

Hard-linking Energy and Economy models based on a Dynamic Input-Output framework

Topic: IO modeling: Conjoined Modeling Approaches

Author: Matteo Vincenzo Rocco

Power sectors are recognized as pivotal in meeting long-term national environmental targets. For this reason, it is fundamental to develop methods and models able to comprehensively assess the economy-wide implications due to implementation of new energy technologies or energy policies.

The scope of bottom-up models is usually limited to the national power sector, by determining its power output on an hourly basis with high technology disaggregation, or by planning optimal future capacity investments. However, these models are unable to capture the linkages between the power sector and other sectors of the economy. On the other hand, top-down macroeconomic models provide a comprehensive picture of the economy, but they suffer from high space and time aggregation, being unable to represent the behavior of power technologies with high temporal detail. Several attempts to link bottom-up and top-down models can be found in the literature: despite this, a fully dynamic, integrated energy-economy model is still lacking.

In this paper, the Duchin's Rectangular Choice of Technology model (RCOT) is reformulated based on a Dynamic input-output framework: technical coefficients and final demand of electricity (per hour) and of other products (per year) are exogenously provided to the model, which endogenously returns the optimal power production mix by energy technology and consumption by sector on an hourly basis, in order to meet a set of given technical and economic constraints. The model is applied to Italy in 2011 as case study, based on data retrieved from Exiobase v.3, International Energy Agency and by the Italian electricity distribution institution.

Results of the case study reveal that the proposed approach may be suited for investigating several research issues, by comprehensively considering the linkages among all the national productive sectors (e.g. technologies integration, economic policies, competition for natural resources, etc.).