Variable Resource Stock Availability and Reserve Capacity Over Time: Toward a Dynamic Rectangular Choice-of-Technologies Model

Topic: (2.5) Special Session: Modelling Sustainable Development: Revisiting Dynamic Input-Output Analysis
Author: Nathaniel Paul Springer

Abstract: Assuring a stable and affordable supply of natural resources is an essential condition for maintaining and improving global economic security and long-term global sustainability. Yet as known endowments are utilized and existing reserves are drawn down, existing or increasing demand must be 1) extracted at a faster rate 2) replaced by accessible new reserves 3) substituted with other resources, all three which likely require investment and the application of technologies previously not developed or applied in the endowed region. It remains unclear how this continued or increased resource use over time will affect long-term sustainable resource access and prices. This paper explores this research question by creating an expansion of the Rectangular Choice-of-Technologies (RCOT) model (Duchin and Levine 2011) to include the dynamics of resource endowment use, capacity investment, and technological utilization. It builds upon the existing dynamic input-output model proposed by Duchin and Szyld (1985), utilizes the distinction between resource and reserve grades defined in Springer (2017), and expands the current linear programming (LP) basis for RCOT to include recursive time-steps (Day 1967). I then apply this dynamic RCOT model to the case of future global phosphate ore extraction. The scenario results, showing regional and globally averaged phosphate ore extraction over time, illustrate the usefulness of this approach for determining the future availability and cost of natural resource extraction (compared to alternative approaches such as Hubbert curves).

References
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Note: This talk is for the special session "Modeling Sustainable Development: Revisiting Dynamic Input-Output Analysis".