Resource Constraints, Technology Choice, and Equity in Global Forestry Value Chains: An RCOT Application

Topic: Input-Output Modelling: Trade and Global Value Chains policies (3)
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Forestry has gained renewed attention due to its dual role in climate transition and international trade, raising questions about carbon storage, land-use competition, bio-based industrial substitution, and employment. At the same time, the global value chain is quite fragmented: countries differ in forest endowments, productivity, in their ability to capture value added in downstream stages, and in their exposure to international trade shocks. This paper addresses the distributional and structural dimensions of that fragmentation by developing an empirical Rectangular Choice-of-Technology (RCOT) model for forestry-related production in a multi-regional setting.

The RCOT framework, developed by Duchin and Levine (2011) and extended in its Ricardian interpretation by Steenge, Bouwmeester, and Carrascal-Incera (2019), treats each countryâ€™s production process as a distinct technology. The model jointly considers inter-industry structure, factor endowments and scarcity, and relative factor prices. Baseline factor prices are set exogenously, while scarcity rents emerge endogenously when factor constraints bind. This allows us to identify, for each stage of the forestry chain (wood processing, pulp, paper, furniture), which country operates as the least-cost producer, which technology generate the largest rents relative to international prices, and which country effectively sets the world price of these products. This framework is specially well suited to understanding forestry production processes, where land availability and quality, water availability, and labor-cost differences can change the geography of production and the incentives to process domestically versus export semi-processed outputs.

The model is calibrated using EXIOBASE 3.8.2 and its satellite accounts for 2022. The base system has 21 regions and 30 sectors. For the first step, we reorganize the benchmark into a rectangular 21 x 42 matrix: rows correspond to regional outputs, and columns represent two activity groups per region: (i) forests and (ii) all other sectors aggregated. In the next steps, we expand the set of forestry-chain technologies by adding region-specific columns for additional sectors of interest (starting with pulp, and then extending downstream, e.g., paper and wood). The factor block includes labor (three skill categories), land (productive/good and marginal/bad forest land), a capital-related proxy, and blue water withdrawal (used in the pulp and paper steps). Labor and land prices are calibrated from observed remuneration proxies (e.g., compensation per job and land remuneration per hectare), preserving regional heterogeneity. Since capital prices are harder to harmonize across regions and sectors at this stage, we use a proxy and test sensitivity.

Beyond the baseline calibration, we perform a set of simulations (varying final demand levels, input prices, and tariff shocks) to trace how cost changes reallocate production across countries and processing stages, and to identify which countries are most exposed to each type of shock. Results are reported as changes in regional production shares by stage, changes in regional value added, and the distribution of the rents generated across countries.

This paper contributes in two ways. Methodologically, by showing how global multi-regional input-output data can be reorganized into a resource-constrained technology-choice framework. Substantively, it shifts the analytical focus from footprint accounting to distributional questions: where value is captured along the forestry chain, and where resource scarcity is most economically binding.

References

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