A Stock-Flow Consistent Input-Output model to study the relevance of interindustry product flows in green energy transition policies

Topic: Recent Developments in Stock-Flow Consistent Input-Output Modelling - I
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Our model aims to provide relevant contributions to the literature through innovations in modelling methodology and by addressing research questions related to the energy transition.

As for the modelling methodology, we build what is one of the first macroeconomic models that fully integrates the methodology underlying the Leontief input-output quantity model with heterodox dynamic macro-modelling. In addition to a household, a bank, a government, and a central bank, our framework features six highly interdependent industrial sectors, producing five types of goods: minerals, fossil fuels, manufacturing goods, miscellaneous goods/services, and electricity through either renewables or fossil fuels. Each industry needs intermediate inputs and investment goods from all the others in order to produce.

We improve upon the Leontief model by (i) introducing production constraints that can arise from limits in the availability of capital or intermediate inputsâ€”with rationing in the supply of goods by the constrained sectors that may follow either the Mixed model approach or a strict proportional rationing rule; and (ii) by allowing for perfect substitutability between green and brown electricity (with grid priority for the first), thereby departing from the assumption of perfect complementarity between intermediate inputs that is typical of input-output models. These two novelties of our model introduce non-linearity in an otherwise linear input-output industrial production framework.

The model follows the Stock-Flow Consistent macroeconomic methodology that has gained increasing popularity during the last fifteen years.

The model is intended to represent the world economy, with a single representative country. Industriesâ€™ technical coefficients, as well as their greenhouse gas (GHG) emission intensities, are calibrated from the Exiobase dataset. The latter also provides the proportions of goods involved in industriesâ€™ investment process. Industriesâ€™ initial capital stocks, their capital productivities and capital depreciation rates are estimated from the EuKlems database.

Two paths are exogenously set regarding the development of renewable power capacity: a business-as-usual scenario, and a Net Zero by 2050 scenario. The model shows the different implications of the two scenarios in terms of GDP growth, investment, GHG emissions, electricity and fossil fuels requirements, and industriesâ€™ relative weight. For instance, the Net Zero scenario features a relatively higher weight of the minerals industry, compared to the BAU scenario, due to the critical role minerals play in the development of renewable power capacity. While the Net Zero scenario is characterized by lower intermediate input requirements in terms of technical coefficients, thereby suggesting a lower production level and thus a lower overall implied investment level compared to the BAU, the higher investments in the electricity sector due to the green transition may more than balance off.

The macroeconomic and environmental effects of the energy transition depend largely on the capital intensity and energy intensity of the green electricity sector, which in our model are still arbitrary to some degree, due to lack of data. Therefore, our work explores the parameter conditions under which the Net Zero scenario may lead to lower/higher GDP growth and lower/higher GHG emissions compared to the BAU scenario.