Inter-industry linkages influence speed and scope of innovation diffusion in the energy transition

Topic: Energy Input-Output Modeling I (Chair: Kirsten S. Wiebe, SINTEF)
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The energy transition progresses at different speeds globally, with some industries in some countries being at the forefront, while in other industries or entire countries there is hardly any progress. From innovation network analysis we know that innovation activities are highly concentrated among actors that closely collaborate, and technologies diffuse faster in closely connected networks. The Porter Hypothesis additionally links technological progress with strict environmental regulations. Andersen et al., (2020) suggest that a more integrated understanding of the relationship between industrial transformation and sustainability transition is necessary. They identify three issues that require further analysis to enhance the political legitimacy of sustainability transitions: 1) the role of inter-industry linkages, 2) the influence of the current knowledge base, and 3) policy challenges in the multi-sector economy-wide transition process.

Here, we focus on the first two issues and assess the scope and scale of the interlinkage between inter-industry dependencies and the current knowledge base on the speed of the energy transition and, vice-versa, the effect of the energy transition on the industrial structure. The state and speed of the energy transition are measured using the change in CO2 emission intensity by industry over time and the current knowledge base is estimated using the number of innovations in environment-related technologies. Measures of inter-industry connectedness are derived from input-output tables: direct input as well as output coefficients, backward and forward linkages, both intra- and interregional, and inverse-important coefficients.

We empirically test the hypothesis, that environmental innovations depend, among other known factors, such as environmental regulations, also on the technological progress (environmental innovations) in closely connected industries using a panel data model. That is: closely related industries have a similar speed of transition. We differentiate between between-sector spillovers (Jacob spillovers) within and across countries and within-sector spillovers (Marshall-Arrow-Romer spillovers) across countries (Hidalgo, 2021). In addition, we use the above results in a two-stage/instrumental variable approach, where the CO2 emissions at the industry level are the dependent variable as the goal of the energy transition is to decrease GHG emissions from fossil fuel burning. As explanatory variables that determine the level of CO2 emissions, we use inter-industry dependencies in addition to environmental innovations, as well as other local factors, such as access to renewable energy sources.

We use the following OECD databases to obtain an (unbalanced) panel dataset covering the relevant industries in all OECD and some non-OECD countries:
- Innovation in environment-related technologies (1990, 2000, 2005, 2010-2015)
- Environmental policy stringency: (1990-2015)
- Inter-country input-output tables https://oe.cd/icio and its CO2 emission and employment extensions (1995-2018)

Combining the knowledge on how low carbon energy technologies diffuse around the world through inter-industry linkages with data on employment by industry/country, provides empirical data on possible effects of the energy transition on the labour market. Here, both the effect on upstream and downstream jobs as well as emissions can be quantified. This analysis will provide supporting information for the just transition, as e.g. envisioned in the European Green Deal.