

## Identifying Technology Clusters with Similar Production Technologies and Its Policy Implications

Topic: Input-Output Analysis: Sustainable Production and Consumption Policies - VI

Author: Waka Nishifuji

Co-Authors: Haruka Mitoma, Kayoko SHIRONITTA, Shigemi KAGAWA

The Paris Agreement (2015) argued that, as a world-wide effort to deal with the threat of climate change, developed countries need to achieve financing, technology development, and technology transfer to support developing countries. To achieve the common goal of reducing global CO<sub>2</sub> emissions, it is important for both technology owners (e.g., developed countries) and users (e.g., developing countries) to have a deeper understanding of the environmental impacts derived from their own production technologies. And through effective policies, countries need to efficiently improve their production technologies toward building a low-carbon society.

We should also pay attention to the environmental impacts of imported goods as well as domestic goods. Countries should understand the environmental impacts derived from the production technologies of their trade partners and take a responsibility for the indirect environmental impacts they induced by trade, either by carrying out technology transfers from their own countries to import partners or by supporting technology transfers from other countries.

Who should offer their technology and who should be offered it is the important question to achieve mitigation of CO<sub>2</sub> emissions through a technology transfer. The Paris Agreement does not provide workshop guidelines or opportunities to discuss how countries achieve CO<sub>2</sub> reductions through a technology transfer. Many studies discussed the effect of technology transfer based on the grouping of countries according to the size of economy (e.g., GDP). However, one concern that is often raised when implementing technology transfer is the disparity in technology levels between the technology offering countries and offered countries. It has been argued that if the disparity is too large, the cost of introducing and operating new technologies may be enormous and the technology transfer itself may be ineffective (Ando, 2003). Therefore, it is important to focus on the similarity in the production technologies to develop technology transfers successfully.

This study is the first attempt to divide countries in groups according to the similarity of their production technologies and estimate the CO<sub>2</sub> emission reduction potentials achieved by technology transfers between the groups.

We used the World Input-Output Database (WIOD) and grouped the production structures (i.e., input coefficient matrices) of 43 countries and regions in 2014 by applying the Ward method, a hierarchical clustering method. It should be noted that the cluster analysis identifies a specific cluster belonging to countries and regions with similar production technologies. The technology cluster analysis based on the input-output tables sheds light on an importance of technology transfers between technology clusters.

As a result, six clusters were identified from the WIOD database in 2014. Furthermore, we estimated the carbon footprint (consumption-based CO<sub>2</sub> emissions) of each technology cluster, and we found that there exists a large gap in the average carbon footprint of the countries belonging to the clusters. The comparison of the carbon footprints of the technology clusters founded in this study will help governments understand their own environmentally inefficient industries and suggest countries that they should request technology transfer for those industries. We also found that technology transfer according to the results of this study have the potential to reduce CO<sub>2</sub> emissions in a country's manufacturing industry by 10 to 20% on average.