International Competitiveness and the Carbon Footprint of Products

Topic: Input-output Analysis for Policy Making (4)
Author: Haruta Togasaki
Co-Authors: Ai Nagata, Shigemi KAGAWA

To achieve a decarbonized society, it is essential to analyse the environmental impacts of changes in trade and industrial structures. In particular, the automotive industry not only plays a crucial role within the global value chain but also significantly contributes to CO2 emissions across countries through the automobile value chain. For a case study, Tokito (2018) showed that more than 90% of the COâ‚‚ emissions induced by the final demand of transport equipment manufactured in Japan in 2013 were indirectly emitted through its global supply chains, equivalent to 6.8% of Japanâ€™s total emissions then. A critical research question is how the international competitiveness of the automobile sector influences CO2 emissions throughout the automobile value chain.

This study examines the international competitiveness of the automotive industries in 44 countries and regions worldwide from 2000 to 2014, as well as the value added and COâ‚‚ emissions indirectly generated by the final demand for these automotive products. The primary objective is to uncover the impacts of changes in the international competitiveness of the automotive industry on the economy and the environment (i.e., COâ‚‚ emissions) in these countries.

In doing it, the World Input-Output Tables (WIOTs), including 56 industry sectors across 44 countries and regions from 2000 to 2014, are used to determine the annual international competitiveness of each countryâ€™s automotive industry. Specifically, the revealed comparative advantage (RCA) index is used to calculate the annual international competitiveness of each countryâ€™s automotive sector.

Subsequently, we estimated the value added and COâ‚‚ emissions indirectly generated across various industries and countries worldwide, associated with the final demand for the automotive industry in each country on an annual basis. These calculations are performed using the Leontief inverse matrix and the relevant factor coefficient vector for 44 countries and regions, specifically the direct sectoral COâ‚‚ emission coefficient vector or the direct sectoral value-added coefficient vector, by year. Additionally, the environmental efficiency of each countryâ€™s automotive sector is calculated and discussed by dividing the induced COâ‚‚ emissions by the induced value added.

The results show that the top five countries with the highest international competitiveness in the automotive industry in 2014 were Hungary, the Czech Republic, Germany, Japan, and Mexico, in that order. In these countries, automotive production in 2014 generated the largest amounts of value added and COâ‚‚ emissions indirectly within their â€˜'Electricity, Gas, Steam, and Air Conditioning Supplyâ€™' sectors.

A simple linear regression analysis between environmental efficiency and RCA from 2000 to 2014 revealed a trend whereby, as a countryâ€™s international competitiveness in the automotive industry improves, its environmental efficiency (i.e., COâ‚‚ emissions per unit of induced value added) tends to increase. This trend was particularly pronounced in Europe, where induced COâ‚‚ emissions were not concentrated solely in the country of production but were instead dispersed across supply chains to nations with lower environmental burdens or higher production efficiency.

According to Antweiler et al. (2000), the effects of free trade on the environment can be broadly categorized into three channels: technology, composition, and scale effects. We found that in the European Union (EU), which promotes free trade within its region and enforces stringent

environmental regulations, the technology and composition effects have played a particularly significant role in reducing the environmental impact of automotive production. Based on our empirical findings, we propose further promoting free trade to enable each countryâ€™s automotive industry to distribute production processes to regions with lower environmental burdens and higher production efficiency, thereby contributing to the global reduction of COâ„ emissions. The novelty of this study lies in its global value chain analysis of automotive products, with particular attention to capturing the role of international competitiveness in the world economy and the environment.