

The Effects of Productivity Improvement on Global CO2 Emissions

Topic: (8.1) Productivity and efficiency analysis

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Climate change is a crucial problem for our society and all the countries need to effectively reduce the greenhouse gas emissions such as CO2 emissions by improving their productivity. Productivity improvement decreases the ratio of input to output and thus contributes to the reduction in CO2 emissions. An important question is how to estimate the productivity in a country.

The Data Envelopment Analysis (DEA) has been widely used to estimate productivity of Decision Making Units (DMUs). This methodology considers input and output factors used in the production process, and estimates productivity of DMUs in the sense that input factors are minimized while ensuring the quantities of output factors referring to the production frontier. Adopting this methodology, we can estimate the effect of productivity improvement on CO2.

Firstly, this study identified the set of efficient production technologies (i.e., production frontier) of 14 metal sectors of EXIOBASE using the DEA framework considering domestic output as an output factor, and labor, capital stock, energy uses, electricity use and other intermediate input as input factors. Data of EXIOBASE of 40 countries in 2007 is applied. Then we estimated consumption-based CO2 emissions (i.e., carbon footprint of nations) using the actual multi-regional input-output tables and ones using the modified multi regional input-output tables that include efficient sectoral inputs estimated by the DEA.

From the results, we found that manufacture of basic iron and steel sector and copper sector are inefficient in some countries like China or India in the sense that those technologies can decrease inputs while ensuring their output quantities by shifting their inefficient production activities to the production frontier. We finally conclude that consumption-based emissions can reduce considerably by improving their productivity referring to the production frontiers of 14 metal sectors estimated by this study.