

## **Effects of Sector Aggregation on Production Functions: A Study on Substitutions between Production Factors**

Topic: (8.2) Methodological Aspects of Input-Output Analysis (3)

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Rapid transformations in industrial activities are urgently required due to the need to reduce environmental pressure as populations and economies grow. Researchers have constructed models of industrial processes to simulate the transformations, in which production functions are often used to examine substitutional relationships between production factors in aggregated sectors. Input-Output (IO-) time series are suitable to initially examine changes in the capital and labor involved and energy and material consumed in the industrial processes of specific sectors. This procedure serves as a foundation to further investigate the fit of those changes in production functions.

This study aims to investigate the adeptness of different production functions comprising capital, labor, energy, and material to describe changes in economic activities over time, across regions, and with sectoral aggregation. EXIOBASE 3.0 serves as reference IO-database due to its detailed sectoral resolution to facilitate aggregation and its rich historical time series from 1995 to 2011. Capital-intensive, labor-intensive, energy-intensive, and material-intensive sectors will be selected cases for further analysis. Production functions of those sectors are modelled on different levels of sectoral aggregation in a bottom-up manner. Selection of aggregation level is critical since substitutability assumption might be expedient in aggregated level, but its practicability is limited in individual production plants.

Production functions generated from this study provides statistical evidence in selecting appropriate levels of aggregation and functional forms and characterizing technological structure in selected sectors and countries. This study provides understanding of substitutions between production factors in an aggregated sector, which can assist policy makers in developing appropriate economic strategies based on national characteristics of each countries. The result exhibits at which aggregation levels significant degrees of substitution between production factors exist. It also indicates the possibilities for substitution between capital stock and material input as well as energy and labor required, depending on aggregation level.