

Index Decomposition Analysis

Index decomposition analysis (IDA) is an analytical tool that was first used by researchers to analyse electricity consumption trends in industry in the early 1980s. The objective was to disentangle the impact on electricity consumption of changes in industrial output structure from that in industrial sector energy intensities. After 1990, studies for other energy consuming sectors, namely transportation, residential and service, began to emerge. At the same time, rising concerns about global warming and environmental sustainability led to a rapid growth in the use of IDA to study energy-related CO₂ emissions.

Following the initiatives undertaken by several national and international organizations in the 1990s, IDA has also been adopted by a growing number of countries (Australia, Canada, New Zealand, United States, etc.) and international organisations (International Energy Agency, European Union, World Bank, etc.) for tracking economy-wide energy efficiency trends. As an example, it is currently being used by the World Bank and the International

Energy Agency as the tool for tracking progresses made in energy efficiency globally in the Global Tracking Framework of Sustainable Energy for All (SE4ALL, 2013), a global initiative led by the Secretary-General of the United Nations.

In the past few years, application of IDA has expanded beyond the traditional areas of energy and emissions. New application areas reported include water use, material and resource requirements, food production, pollutant emissions, and toxic chemical management. Traditionally IDA has been applied to analyse past developments, i.e. retrospective analysis. A growing number of prospective analysis studies have emerged recently, such as making future

forecasts, unravelling projected energy savings or reduced emissions, and harmonizing and comparing results across different models and scenarios.

IDA has strong linkages with index number problems in statistics and economics, as well as with systems design and management. Although the basic concept was largely formalized in the 1980s, refinement to the methodology has continuously been made by researchers. Examples are the search for methods that produce decomposition results without leaving a residual term, catering to cases where decomposition involves many factors, spatial decomposition analysis, integrating physical and economic activity indicators in the analysis, and ensuring consistency in aggregation when the data set is multi-subcategory.

With such refinement and to cater to a growing number of application areas, there have been changes and convergence with regard to the IDA methodology. Prior to 1990, decomposition analysis was conducted largely based on the concept of the Laspeyres index. In the 1990s, a gradual shift towards the Divisia index was observed. Since the mid-2000s, the most popular IDA approach has been the logarithmic mean Divisia index (LMDI) decomposition methods. To a large extent, the LMDI decomposition methods have become the de facto methods in IDA among researchers.

More than 30 years since it was first proposed, IDA and its application continue to attract considerable interest among researchers and policy makers. Over the years, researchers in the Department of Industrial and Systems Engineering have done pioneering work in the area, including coining the term “Index Decomposition Analysis” and the development of the popular LMDI methods. Research is being undertaken to push the frontier further, both on the application and methodological fronts.

Further information about recent IDA publications of the department and the LMDI decomposition analysis can be found at the following links:

- <https://scholar.google.com.sg/citations?user=gLQsgi8AAAAJ&hl=en>
- http://www.ise.nus.edu.sg/staff/angbw/pdf/A_Simple_Guide_to_LMDI.pdf