Input-Output for Dummies

Lecturer:
Erik Dietzenbacher (University of Groningen, Netherlands)

Background

Nowadays, people are well aware of the fact that the goods and services we consume are made in global supply chains. This is because Japanese cars, for example, include South Korean parts which use Chinese-made wiring. So, every Japanese car contains indirectly some Chinese production. Therefore, it also contains a little bit of Chinese labour and has caused some CO_2 emissions in China. Input-output is a tool that has been used widely to get some grip on aspects related to production in the presence of global supply chains. Instead of studying supply chains for a specific product, input-output (IO) examines the effects at the industry, the country, or the global level.

Many practitioners apply IO in a rather mechanical way and have built up expertise in specific aspects. However, a full overview of the models and their possible applications is lacking. This module provides a brief, one-day introduction to IO.

Typical questions are the following. How much high-skilled labour in the UK is involved in satisfying the demand for German cars by households in Australia, reflecting trade in production factors? What is the greenhouse gas footprint of China, or how large are the Chinese "exports" of greenhouse gas emissions? What percentage of the growth in French GDP between 2000 and 2014 was due to the increased household consumption in the rest of the EU? To analyse these questions Global Multiregional Input-Output (GMRIO) tables are used.

Objectives

- The overall learning goal is to get participants acquainted with:
  - the methodologies and the large databases used in IO analysis,
  - the topical discussions in the recent literature.

- Upon completion of this module, the applicant is able to:
  - help her/himself further and expand her/his knowledge, for example by reading Miller and Blair's textbook on IO,
  - read and understand scientific papers with simple applications of IO,
  - identify cases where IO techniques can be applied meaningfully,
  - analyse and interpret the outcomes of IO analyses,
  - critically evaluate the working of the IO model in applications.

Session 1: A Crash Course in Input-Output

This session gives a brief introduction of IO, starting from scratch. We begin with very simple IO table and make assumptions that allow us to build a model with which real-world exercises are carried out. We will develop the quantity and the price model, and touch upon some extensions. We will critically evaluate some of the model's assumptions (and implicitly answer the question for which problems IO might be used, but also for which questions is IO not recommended).

Session 2: Global Multiregional Input-Output (GMRIO) Tables

This session deals with GMRIO tables because many real-world issues related to global supply chains are analysed with such tables. Although they are huge and may look frightening, the key message is that there is nothing to be afraid of.

Session 3: Global Value Chains

Vertical specialization, international fragmentation, global supply chains, offshoring and reshoring, globalization and slowbalization are the modern buzzwords. They are all related to the fact that goods and services are produced in chains that cross many borders. As a consequence, US products include some Chinese labour. This led President Trump to try and make us believe that the Chinese were stealing US low-skilled jobs. Because we are all acquainted with the buzzwords (whereas they are usually not well defined), this also leads to confusion. For example, what is the difference between "Value Added in Trade" and "Trade in Value Added"?

Session 4: Emission Footprints

Based on the idea that any action in any place has environmental consequences on the other side of the globe, this session deals with trade in emissions. Similar to the previous session, we will discuss the difference between "emissions in exports" and "exports of emissions". We will distinguish two types of emissions accounting: production-based and consumption-based accounting. The latter is at the heart of footprints. If time allows, we will also pay attention to quantifying what has driven the growth in, for example, global greenhouse gas emissions.

Prerequisites
   − None.

Preparation
   − None, other than refreshing the basics of matrix algebra (from your first year's course in mathematics).

National Accounting Matrices (NAM): Building and modeling the Effect of Interindustry R&D Spillovers for policy analysis

Lecturer:

Luis Pedauga (European Commission's Joint Research Centre, Spain)

Summary of the Training Session:

This course provides a strong theoretical foundation and hands-on experience in building National Accounting Matrices (NAM) according to the new recommendations of System of National Accounts 2008 and introduces the guidelines on how to analyze the elements related to the Research and Development (R&D) accounts. On the one hand, a NAM is defined as the presentation of the SNA accounts in a matrix, which elaborates the linkages between the supply and use table and the institutional sector accounts. On the other hand, the R&D accounts are related to technological progress and economic growth. The traditional fundamental for the compilation of National and Social Accounting Matrices lies with structural features such as income and expenditure distribution among sectoral groups. Nevertheless, the content of the course goes beyond the generalized input-output framework for calculating simple multipliers by considering the elements related to the R&D investment. Since R&D spillovers effects can be transmitted through various channels, the input-output analysis allow a quantitative method for comparing the structure and performance of inter sectoral innovation diffusion embedded in the economics innovation systems. To cover this content, it will be taught through the guidelines and recommendations given by the System of National Accounts, which in turn are based on the Manual of System of National Accounts 2008 of the United Nations.

Structure and Contents of the Course:

First Session – The SNA Overview: 1h 30m
1. The System of National Accounts 2008
2. Input-Output Matrices (IOM) and the Integrated Economic Account (IEA)
3. Incorporating a from-whom-to-whom (FWTW) framework

Second Session – Assembling the NAM: 1h 30m assembling
1. Sectoral accounting matrices from the IEA
2. Interpretation and analysis of the matrices
3. Identifying R&D accounts (Who is producing, financing and using R&D?)

Third Session – Extensions of the NAM and R&D accounts: 1h 30m
1. The Satellite Accounts framework derived from SNA
2. Research and Development recognized as capital formation
3. Example satellite accounts for R&D investments.

Fourth Session – Derivation of R&D accounting multipliers: 1h 30m
1. Introduction to modeling with matrices.
2. Scenario building and single and multiple objective instruments.
3. Interindustry R&D impact assessment using multiplier analysis.

Prerequisites: A basic knowledge of input-output and national accounts is helpful. The course will follow a process of "learning by doing", so it is recommended that participants have their own computers with MS Excel 2016 installed (the theoretical concepts, such practical activities will be implemented by using nested formulas and matrix algebra in spreadsheets).

Suggested References:

Aray, H., Pedauga, L., & Velázquez, A. (2017). Financial Social Accounting Matrix: a useful tool for understanding the macro-financial linkages of an economy. *Economic Systems Research*, 29(4), 486-508.

Eurostat (2014) *Manual on the changes between ESA 95 and ESA 2010*. Luxembourg. Publications Office of the European Union.

Dietzenbacher, E., & Los, B. (2002). Externalities of R&D expenditures. *Economic Systems Research*, 14(4), 407-425.

Pedauga, L., Velázquez, A., & Bueno, M. (2018). Property income from-whom-to-whom matrices: A dataset based on financial assets–liabilities stocks of financial instrument for Spain. *Data in brief*, 19, 449-455.

Miller, R. E., & Blair, P. D. (2009). *Input-output analysis: foundations and extensions*. Cambridge university press.

Mohnen, P. (1997). Introduction: input–output analysis of interindustry R&D spillovers. *Economic Systems Research*, 9(1), 3-8.

United Nations, Commission of the European Communities, International Monetary Fund, Organization for Economic Co-operation & Development and World Bank (2008). *System of National Accounts 2008*. Brussels, World Bank.

Working with Inter-Country Input-Output tables and related GVC indicators

Lecturers:

Norihiko Yamano and Colin Webb

Background

For the past twelve years OECD has developed, updated and maintained Inter-Country Input-Output (ICIO) tables and produced indicators related to global value chains (GVCs) to contribute to analysis and policy discussions related to economic globalisation. The first edition of ICIO tables was published in 2013 along with a set of Trade in Value Added (TIVA) indicators. Subsequent developments resulted in the publication of indicators of Trade in employment and Trade in Embodied CO_2.

The latest edition of ICIO tables and TiVA indicators, released in November 2021, cover the period 1995 to 2018, 45 unique industries (based on ISIC Rev.4) and 67 economies (including *Rest of the World*). The current geographical coverage includes all 38 OECD countries, all G20, all European Union and all ASEAN countries.

Objective

This course is an opportunity for students to learn about OECD's work on developing ICIO tables and related indicators: how ICIO tables are constructed, their structure and characteristics, and how they are used to generate TiVA and other GVC indicators at OECD. A key aim is to equip students with the knowledge and tools to develop their own indicators and GVC analyses (for dissertations, thesis, papers etc.) using ICIO tables, and how to interpret the results.

Session 1: Introduction - Overview of OECD's ICIO and TiVA Indicators databases

- Structure and characteristics of ICIO tables
- Description of the current set of TiVA indicators
- Description of other sets of GVC-related indicators
- Where to find and how to download the databases

Session 2: Working with OECD's ICIO tables

- How to work with the "R" and CSV files
- How to export the data to Excel
- How to work with and treat two important features of the ICIO tables:
  - ✓ China and Mexico split;
  - ✓ Final consumption expenditure of resident households abroad

Session 3: Working with OECD's TiVA Indicators

- How they are generated from ICIO tables
- How they are interrelated and interconnected
- How they should be interpreted and used (including caveats)

Session 4: Extensions of ICIO

While the first three sessions are devoted to the understanding of the structure of the OECD databases, this session will explore further the potential of ICIO tables to contribute to various policy discussions related to globalisation such as employment in GVCs, carbon footprints, tourism and GVCs and, the impact of recent shocks to the global economy. This session will also give students the opportunity to present their own research using OECD's databases and allow them to provide feedback on their experiences.

Prerequisites

- ✓ Basic knowledge of Interregional Input-Output Analysis
- ✓ Bring your own laptop (Windows/MacOS with 8GB+ memory recommended)

Preparation

Exploring some of the OECD databases and related documentation in advance could be beneficial:

- OECD Inter-Country Input-Output (ICIO) tables

  Yamano, N. et al (2022, forthcoming) *Development of the OECD ICIO Database*
  Access to the latest database: http://oe.cd/icio.

- OECD Trade in Value Added (TIVA) indicators

  Martins Guilhoto, J., C. Webb and N. Yamano (2022), *Guide to OECD TiVA Indicators, 2021 edition*, OECD Science, Technology and Industry Working Papers, No. 2022/02, OECD Publishing, Paris, https://doi.org/10.1787/58aa22b1-en. *Access to the latest database:* http://oe.cd/tiva

- OECD Trade in Employment (TiM) Indicators

  Horvát, P., C. Webb and N. Yamano (2020), *Measuring employment in global value chains*, OECD Science, Technology and Industry Working Papers, No. 2020/01, OECD Publishing, Paris, https://doi.org/10.1787/00f7d7db-en. *Access to the latest database:* http://oe.cd/io-emp

- OECD Trade in Embodied CO2 (TECO2) Indicators

  Yamano, N. and J. Guilhoto (2020), *CO2 emissions embodied in international trade and domestic final demand: Methodology and results using the OECD Inter-Country Input-Output Database*, OECD Science, Technology and Industry Working Papers, No. 2020/11, OECD Publishing, Paris, https://doi.org/10.1787/8f2963b8-en. *Access to the latest database:* http://oe.cd/io-co2

Recommended reading

- Economic Systems Research, Volume 25, 2013 - Issue 1: Global Multiregional Input–Output Frameworks

- Miller R.E. and P.D. Blair (2009) *Input-Output Analysis: Foundations and Extensions*. Englewood Cliffs: Prentice-Hall.

- Isard W et al. (1998) *Methods of Interregional and Regional Analysis*. Ashgate, Brookfield, VT

Historical Roots and Theoretical Background of Input-Output Analysis

Lecturer

Heinz D. Kurz and Christian Lager (University of Graz, Austria)

Introduction

As a starting point the contributions of the Classical economists and their view of a multi-sectoral and circular economy where commodities are produced by means of products and original factors of production are explored. Important concepts such as long run position, prices of production, capital and a uniform rate of profits are to be discussed. Scrutiny reveals that Leontief's predecessors such as François Quesnay, Adam Smith, David Ricardo, Karl Marx, Vladimir K. Dmitriev, Ladislaus von Bortkiewicz and other scholars share common concepts which constitute the core of Classical economic theory. It is demonstrated that Classical economics differ from the contemporary Neoclassical model in many aspects, such as methodology, the notion of equilibrium, the concept of value and distribution, the set of exogenous and endogenous data as well as the underlying crucial assumptions or beliefs. Hence, it seems to be an important issue for scholars working in the field of input-output whether Leontief was a Classical or a Neoclassical economist, to decide which paradigm provides the adequate background for input-output analysis and to conclude which theoretical model should be utilized for one or the other application. Finally the different routes to the theory of production, value and distribution are discussed. Tools and concepts, such as sectoral (dis)integration or period of production, which were developed and utilized in the various contributions of Leontief, von Neumann and Sraffa or some Austrian and Neo-Austrian scholars are discussed and compared and similarities as well as dissimilarities are revealed. Finally, the limitations to the fixed coefficient input output model will be discussed.

Objective

Some if not most studies in the field of input-output are usually not embedded or even linked with economic theory. The proposed module aims at (i) exploring the historical roots of Leontief's approach to input-output and (ii) providing a sound theoretical background for input-output analyses.

Organization and content

We propose the following sessions:

1. Input-output analysis ante literam: The contributions of the Classical economists (Heinz D. Kurz).

2. Switching and re-switching in Leontief´s approach to input-output economics (Heinz D. Kurz).

3. Classical and Neoclassical Economics: Two paradigms and many differences (Christian Lager).

4. The Austrians, Leontief, von Neumann and Sraffa: Different routes to the theory of production, value and distribution; Limitations to the (fixed coefficient) input output approach (Christian Lager).

References

Heinz D. Kurz and Neri Salvadori, Theory of Production, A Long-Period Analysis, Cambridge University Press, 1995.

Heinz D. Kurz and Christian Lager (eds.), Special Issue: Input-Output Analysis and Classical Economic Theory, Economic Systems Research, 12(2): 2000.

Olav Bjerkholt and Heinz D. Kurz (eds.), Special Issue: The History of Input-Output Analysis, Leontief's Path and Alternative Tracks, Economic Systems Research, 18(4): 2006.