Newsletter
International Input-Output Association (IIOA)
Number 19; August, 2012

Editorial

Mapping the structure of the world economy - the new high-resolution Eora MRIO database

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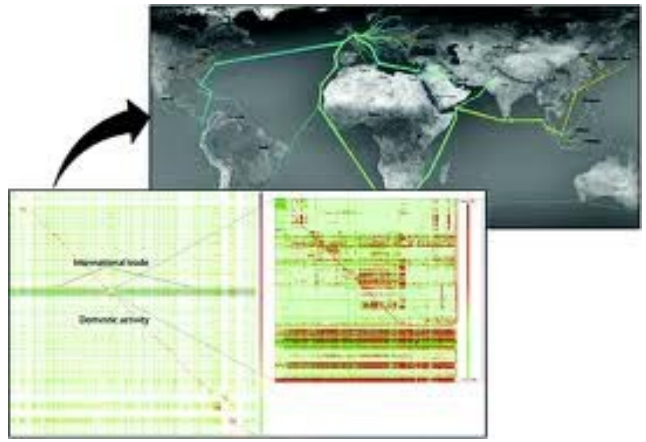
Dear IIOA member,

As international trade and multinational production become ever more important there is a need for economic analysis that doesn't hit walls at national borders. Multiregional I-O tables respond to that need. In particular, I-O analysis is currently in the midst of a renaissance in its use for environmental applications. Its ability to trace out the supply chains linking consumers to the impacts they ultimately drive makes it a powerful tool for guiding policymaking. So far, most environmental policy is based on a principle of producer responsibility, the idea that the company directly causing an impact is responsible for it. But there is growing recognition that the consumers of those implicated products—who ultimately benefit from that environmental harm—should also play a role in reducing their footprint. This idea is called the consumer responsibility principle. China has suggested this principle be used when setting the next round of GHG reduction targets. Up to 40% of China's emissions are due to the production of export goods. Complementarily, the UK has recently been disappointed to find that reductions in its territorial GHG emissions have been more than offset by increases in their carbon footprint embodied in imports.
Successful sustainability policy will consider both producer and consumer responsibilities, and will need to address different challenges at the production, trade, and consumption points along the supply chain.

MRIO schematics of the world economy allow us to trace supply chains and differentiate policy at different stages of the supply chain to achieve a coordinated effect.
The Eora MRIO project had several goals:

1. Preserve all original data from national statistical agencies in its original high-resolution classification (integrity of original data)
2. Provide full country coverage (180+ countries)



3. Provide a continuous time series from at least 1990
4. Provide uncertainty information for all elements

We hoped to significantly advance the state of the art in each of these aspects, and furthermore we hope to accomplish this at a low cost (<$1 million) through the extensive use of software.

In terms of cost, detail, coverage, size, continuity, timeliness, and comprehensiveness Eora successfully raises the bar for MRIO construction (Table 1). The table covers 187 countries with 25-400 sectors per country (for a total of 15,000 sectors) and five valuation sheets, over the period 1990-2009. Eora captures >99.99% of global trade. Every data point is accompanied by an estimate of its standard deviation.

To build Eora we wrote AISHA (An Integrated System for building Harmonized Accounts), a software package that automates the

In this issue

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construction of an MRIO.

AISHA provides a data processing language to help connect together disparate I-O data into a single table. It also provides an optimization module to reconcile conflicting input data and balance the global I-O table.

Mathematically the Eora MRIO table is a multi-dimensional tensor: the basic two-dimensional I-O table is stacked vertically for each of the five valuation sheets (allowing prices to be differentiated between producers price, taxes, subsidies, transport cost, middleman costs, and consumer prices). This three-dimensional stack is available over many years, so time is the 4th dimension. On each of the I-O table sheets we use a tree structure to locate countries, blocks (transaction matrix, final demand block, etc.) and sectors within each block. This tree structure helps us paste together national I-O tables with heterogeneous structures (industry-industry, commodity-commodity, and supply-use tables) and heterogeneous classification schemes.

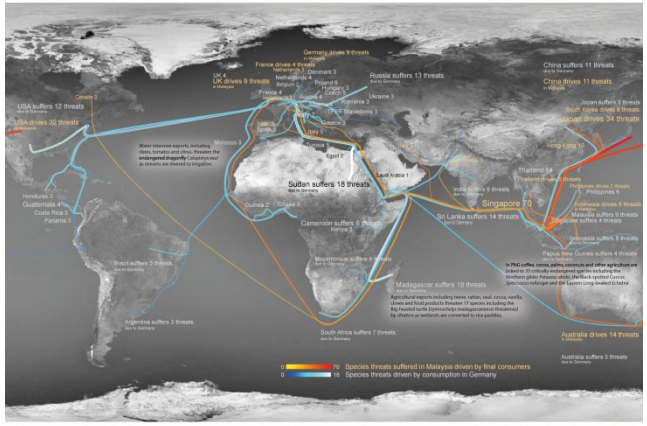

Figure 35: Flow map of threats to species caused by exports from Malaysia (reds), and imports into Germany (blues). Note that the lines directly link the producing countries where threats are recorded, and final consumer countries. Processing stops in intermediate countries are accounted for but not explicitly visualized. Malaysia suffers 488 species threats domestically; exports, including palm oil, rubber, and cocoa, are linked to 276 of those. Germany suffers 321 species threats domestically and drives an additional 395 through its imports. Regional trade patterns can be observed (consumption in Southeast Asia drives impacts in Malaysia; German consumption drives impacts in Europe) but drivers and impacts are linked globally. http://worldmrio.com/biodivmap/

The AISHA data processing language exposes this tree structure to allow us to easily address specific areas of this tensor (e.g. the domestic I-O table or the trade block containing the bilateral sector-wise trade between two countries). Tightly integrated with the language is a deep library of correspondence matrices that help aggregate, disaggregate, and translate data from one classification into another.

Correspondence matrices are an indispensible tool for joining together disparate data by translating between classifications. For example, exports from Algeria are reported in a 25-sector classification but imports into France are reported in a 61-sector classification. Concordance matrices allow us to connect these. For each raw dataset input we wrote a script using the data processing language instructing AISHA where to place the data in the MRIO tensor and what correspondence matrices to apply. AISHA executes these scripts and sews the patches of raw data together into a single large global table. To handle conflicting and disagreeing data we treat each data point not as a fixed value but as an estimate with an associated standard deviation.

Given then that values have an associated uncertainty we can use optimization software to find a balanced MRIO that minimally disturbs the initial table. For the optimization module we had to develop our own software as no commercial package was able to solve a system as large as the Eora MRIO. The Eora matrix itself has 109 elements (9 GB) and it is subject to approximately 106 constraints (balancing constraints, conflicting data, and nonnegativity constraints). In total the optimizer must consider over 40GB of data. Building and balancing the Eora MRIO is computationally intensive: it requires approximately two weeks to rebuild Eora on a purpose-built cluster with 66 3GHz cores, 600GB of RAM and 15Tb of mixed SSD/RAID storage. The table is rebuilt and balanced each time we adjust or add input data.

A recent innovative use of Eora has been to trace products implicated in biodiversity loss to final consumers. Fishing, forestry, agriculture, and pollution in tropical developing countries are heavily responsible for biodiversity threats. Using data on species threats from the IUCN Red List of threatened and endangered species we attributed species threats to the corresponding economic sectors causing those threats, then used the MRIO to trace these implicated commodities to final consumers. That study confirmed that first-world consumer demand drives biodiversity threats in developing countries (http://www.nature.com/nature/journal/v486/n7401/abs/nature11145.html).

The Eora MRIO marks a major step forward in the field of MRIO construction. It provides an unprecedented level of detail and coverage. The novel use of a data processing language and optimizer allow us to incorporate national data in its original detail and still end up with a balanced global I-O table. We will continue to incorporate new raw data into Eora in order to improve the results and keep the MRIO current. Leontief's original I-O table of the US economy took him and 400 staff two years to construct. Most national IO tables built today still require substantial manual effort. Using modern hardware and software we have been able to bind together national and UN data into a global MRIO for a fraction of that cost.

We anticipate MRIO analysis will take a central role in environmental policymaking. From calculating trade-adjusted carbon footprints to conducting supply-chain analysis, high-resolution MRIO tables can help us better understand our globalized economy.

The Eora MRIO is documented in a recet article (http://pubs.acs.org/doi/pdf/10.1021/es300171x). The database is free for non-commercial use and is available online at http://worldmrio.com.

Economics-Environmental Studies Tenure Track

St. Olaf College in Northfield, Minnesota, invites applications for a tenure-track position with a joint appointment in the departments of Economics and Environmental Studies beginning September 1, 2013. The successful candidate will have a teaching and research portfolio focused on economic development and the environment, and will teach courses and cultivate a research program in economic development and the economics of sustainability. Preference will be given to candidates who can contribute to teaching core economics courses in intermediate microeconomic theory or economic statistics, and who also are interested in developing courses that link economic development to such areas as food security, environmental sustainability, urban and regional planning, sustainable agricultural policies, climate change, and/or environmental security.

Send the application to

http://www.Click2Apply.net/vkfrv7s

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Published papers in Input-Output Analysis and related methods.

In the next ESR issue

Economic Systems Research –

Journal of the IIOA

Volume 24, Issue 2 (June 2012)

http://www.tandf.co.uk/journals/titles/09535314.asp

FINANCIAL DISTRESS AND INDUSTRY STRUCTURE: AN INTER-INDUSTRY APPROACH TO THE LOST DECADE IN JAPAN. OGAWA K., STERKEN E. and TOKUTSU I.

This paper proposes a novel approach to investigating the propagation mechanism of balance sheet deterioration in financial institutions and firms, by extending the input–output analysis. First, we use a unique input–output table augmented by firm size dimension. Second, we link the input–output table with the balance sheet conditions of financial institutions and firms. Based on Japanese input–output tables, we find that the lending attitude of financial institutions affected firms' input decision in the late 1990s and the early 2000s. Simulation exercises are conducted to evaluate the effects of changes in the lending attitude toward small firms as favorable as that toward large firms on sectoral allocations.We find that output was increased for small firms and reduced for large firms. The change in output was non-negligible, about 5.5% of the initial output of each sector. In particular, it exceeded 20% in textile, iron and steel and fabricated

DISTRIBUTIONAL INVARIANCE AND THE DESIGN OF SAMS. PYATT P. and ROUND J.I.

The decomposition of a matrix multiplier derived from a social accounting matrix (SAM) by Pyatt and Round [(1979). Accounting and Fixed Price Multipliers in a Social Accounting Matrix Framework. *Economic Journal*, 89, 850–873] has prompted a number of subsequent applications. In one of the earliest examples Stone [(1985). The Disaggregation of the Household Sector in the National Accounts, Chapter 8. In: G. Pyatt and J.I. Round (eds.) *Social Accounting Matrices: A Basis for Planning*. Washington, DC, The World Bank, 145–185] made the intriguing observation that the higher order (circular) effects of an exogenous change in final demand on the distribution of income and the structure of production were more or less independent of the sectoral composition of the initial injection. Our initial objective in this article is to explore this phenomenon of distributional invariance and to derive sufficient conditions for it. We then argue that these conditions have important implications for the design of SAMs, for the taxonomies they adopt and for levels of disaggregation, all of which strongly condition the quality of results that can be generated via subsequent modelling.

HOW MUCH DO EXPORTS CONTRIBUTE TO CHINA'S INCOME GROWTH? PEI J., OOSTERHAVEN J. and DIETZENBACHER E.

It is a widespread belief that exports, in particular of 'high-tech' products, contribute much to China's income growth. This study addresses this issue by applying a structural decomposition analysis to input–output (I–O) data. We employ two extended I–O tables that distinguish processing trade from ordinary exports. The contribution of exports to the value-added growth from 2002 to 2007 is found to be overestimated by 32% when standard I–O tables are used rather than the extended I–O tables. Even more strikingly, the value-added growth that may be attributed to the exports of 'high-tech' telecommunication products is overestimated by no less than 63%. A serious overestimation of the contribution to income growth of certain products (such as high-tech products) sends out misleading signals to policymakers. When measured correctly, the true contribution appears to be substantially smaller than is generally believed to be.

STRUCTURAL DECOMPOSITION ANALYSIS APPLIED TO ENERGY AND EMISSIONS: AGGREGATION ISSUES. SU B. and ANG B.W.

With the introduction of the environmentally extended input–output (I–O) framework, traditional economic I–O modeling and analysis can be conveniently adopted in energy and emission studies. Based on such an extended framework, many empirical studies investigating the driving forces of energy consumption and emission changes using structural decomposition analysis have been reported. Three aggregation issues are inherent in such decomposition studies, namely sector aggregation, spatial aggregation and temporal aggregation. This study, as an extension of our previous work on the first two issues, focuses on the third or temporal aggregation. An empirical study using the emission data of China from 1997 to 2007 is presented to illustrate the problems involved. How to deal with temporal aggregation and its possible interactions with the other two aggregations is also discussed.

FROM INPUT–OUTPUT TABLES TO SUPPLY-AND-USE TABLES. KAZEMIER B., DRIESEN C. H. and HOOGBRUIN E.

In 1991, Statistics Netherlands introduced the supply-and-use tables as part of the national accounts. Since then, the supply-and-use tables have been the main statistics on the production structure of the Dutch economy. They form the basis from which input–output tables are derived. The time series of supply-and-use tables starts in 1987. However, there is a need for a time series since 1970 because benchmark revisions of the Dutch national accounts would become far easier if such time series were available. Therefore, a method has been developed to derive supply-and-use tables from existing input–output tables. This article presents the algorithm.

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Upcoming conferences

The 21st International Input-Output Conference

July 8-12, 2013
Kitakyushu, Japan

The goal of the conference is to promote and stimulate the worldwide exchange of ideas among economists between them and government officials, policy makers, engineers, national accountants and managers with interests in input-output analysis and related methods.

The 3rd edition of the International School of Input Output Analysis will also be held during the same dates.

Further info will be published on the next issues of the IIOA Newsletter and on the IIOA website http://www.iioa.org

The economic crisis: time for a paradigm shift. Towards a systems approach

January 24-25, 2013

Valencia, Spain

VNIVERSITAT DE VALÈNCIA Facultat d'Economia

The Symposium aims to address the causes and reasons of the actual economic crisis from the economic, financial, managerial and entrepreneurial perspectives. In particular the symposium will focus on the epistemological, theoretical, methodological, technical and practical contributions of the systemic approach from a disciplinary or interdisciplinary perspective (finance, management, engineering, economics, etc.) to shape an agenda to address the present global economic and social crisis.

10th of October 2012, abstract deadline

20th of October 2012, author notification

10th of December 2012, final paper submission

31st of October 2012, early registration

Further info at:
http://www.business-systems-review.org/

3rd Workshop of the Hispanic-American Input-Output Society

October 9, 2012
Santiago de Compostela, Spain

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The Hispanic-American Input-Output Society (SHAIO) and the Instituto de Estudios y Desarrollo de Galicia (IDEGA) organise the third Workshop SHAIO. The Workshop will take place on the next 9th of October 2012 in Santiago de Compostela (Spain). This year Michael L. Lahr (Rutgers University) will be the invited speaker.

7th of September 2012, paper submission

14th of September 2012, author notification

Further info at:

http://solar.usc.es/game/?page_id=1696&lang=es

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