

**Newsletter**  
Number 55, February 2023

# INTERNATIONAL INPUT-OUTPUT ASSOCIATION

## Welcome from the Editor



Dear **IIOA** member,

I am very pleased to release the latest issue of the *International Input-Output Association Newsletter*. Many thanks, as always, to all of you that have contributed by sending your inputs.

This issue contains a message from the IIOA President Sanjiv Mahajan, the latest ESR articles and some highlights in Journals. You can also find a job position, the announcement of an event and a new repository released this year. The Social Accounting Corner brings this time conversations with Kenia Barreiro and Jorge Zafrilla. Additionally, in this issue, we have a special word search puzzle created by Mike Lahr for us the solution of the Holiday Acrostics of the last issue. Finally, in this issue, you will also find some words to remember our beloved colleagues that sadly passed away recently.

Any feedback, comments or suggestions are greatly appreciated. I also welcome contributions to future issues.

### **Andre Carrascal Incera**

*IIOA Newsletter Editor*

University of Oviedo, Spain

Newsletter E-mail: [newsletter@iioa.org](mailto:newsletter@iioa.org)

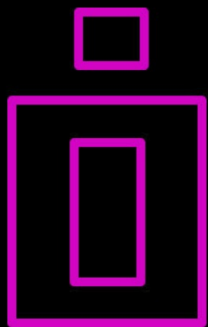
Personal E-mail: [carrascalandre@uniovi.es](mailto:carrascalandre@uniovi.es)

Would you like to contribute to the IIOA  
newsletter?

Send us your news at [newsletter@iioa.org](mailto:newsletter@iioa.org)

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# INTERNATIONAL INPUT-OUTPUT ASSOCIATION

## A message from the IIOA President – Sanjiv Mahajan



Dear IIOA Member,

Hope you and your families are all well, it is amazing how quickly time goes by, April 2023 already!

### Some general IIOA matters

Since the beginning of the year various personnel changes have taken place:

- Elections to the IIOA Council were completed at the end of 2022. Congratulations to the successful members: **Francesca Severini** (new member), **Cuihong Yang** (a returning member) and **Jose Rueda-Cantuche** (continuing member but in a different role).
- The process to select two new Vice-Presidents has also been completed, congratulations to **Jose Rueda-Cantuche** and **Cuihong Yang**.
- Congratulations to **Rosa Duarte** who has started the role as one of the two ESR Editors alongside **Yasuhide Okuyama**. Also, a BIG thank you for the success and efforts over many years to **Manfred Lenzen** as the previous Editor and his help in facilitating the transition.

- We are deep into the process of negotiating a **new contract between the IIOA (ESR) and the publisher Taylor and Francis**. This is extremely important for the IIOA and the ESR, the discussions are going well and should be completed in the coming few weeks. Further details will be provided in the next issue.

### 2023 IIOA Conference

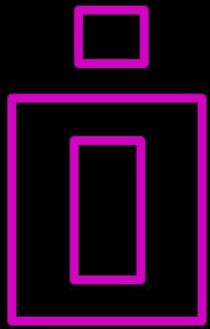
The 29<sup>th</sup> IIOA Conference will be held in Alghero, Sardinia Island, Italy and coming soon (25<sup>th</sup> – 30<sup>th</sup> June 2023). This will be the second consecutive IIOA Conference held on an island.

**Giorgio Garau** (LOC Chair), **Jose Rueda-Cantuche** (SPC Chair) and their respective teams are working hard to put all the Conference arrangements in place. The number of submissions has been very high reinforcing the popularity of the IIOA Conference.

There will be Special Leontief Nobel Prize Sessions celebrating the 50<sup>th</sup> year since Leontief received his Noble Prize. There will also be a classical music concert on the Wednesday and Sardinian dances after the Conference Dinner on the Thursday.

This Conference will also hold the 11<sup>th</sup> Edition of the International School of Input-Output Analysis (ISIOA) - looks like there will be five training modules available.





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## A message from the IIOA President – Sanjiv Mahajan



### 2023 IIOA Conference continued:

We have three excellent keynote speakers:

- **Rutger Hoekstra** (CML) on beyond GDP and inequality;
- **Nadim Ahmad** (OECD) on regional GVCs; and
- **Alessandra Alfieri** (UNSD) on SEEA.



Early registration has opened, please register and benefit from the early-bird rates. I look forward to seeing as many of you there as possible.

In the meantime, for further details of the Conference and the various events that will be taking place, please check out the Conference Website, the link is below:

[The 29th IIOA conference - The Conference](#)

### Some sad news

Last but not least. This issue is tinged with sadness. Recently, we heard the sad news that **Ronald Miller** and **Graham Pyatt** had passed away – both had long distinguished careers in the field of Input-Output and related statistics as well as being IIOA Fellows. I had the pleasure of meeting both and also learning about SAMs from Graham Pyatt through presentations in London in the early 1990s.

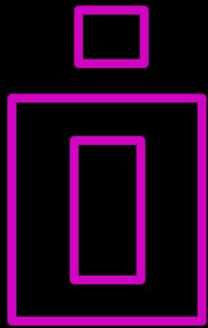
There are two nice articles reflecting the notable achievements of both legends covering decades of commitment and efforts to developing the I-O related domain.

Be safe, take care and have fun.

Best regards

**Sanjiv Mahajan**

April 2023



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# INTERNATIONAL INPUT-OUTPUT ASSOCIATION

## In memoriam

### Ronald E. Miller (1934-2023)

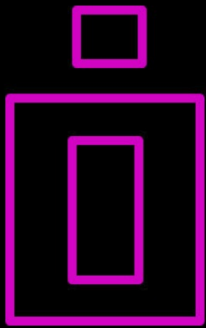
Ronald Eugene Miller, Professor Emeritus at the University of Pennsylvania, died unexpectedly on January 26, 2023. Ron is perhaps best known for co-authoring, with Peter D. Blair, three editions of *Input-Output Analysis: Foundations and Extensions* (1985, 2009, 2022) and for being Managing Editor of the *Journal of Regional Science* from 1963-1996.

Born in Seattle, WA in 1934, Professor Miller received a B.A. in Economics at Harvard University in 1955 under the tutelage of Robert Kuenne, who had written a dissertation under Walter Isard that applied input-output (I-O) analysis. Ron's senior thesis won Newcomen Prize in Business History, part of which was published in 1957 as "The Impact of the Aluminum Industry on the Pacific Northwest: A Regional Input-Output Analysis" in the journal *Review of Economics and Statistics*. After a hiatus as a Fulbright Scholar at the Universities of Heidelberg and Munich in 1956, Ron received an MA in Economics at the University of Washington in 1957 under Assistant Professor Arnold Zellner. He subsequently enrolled as a Ph.D. candidate at Princeton University's Department of Economics. As Ron liked to tell it, his dissertation committee was composed of three secondary authors: Richard Quandt of *Henderson & Quandt* (1958), *Microeconomic Theory: A Mathematical Approach*, an advanced microeconomics textbook standard; Oskar Morgenstern of *von Neumann & Morgenstern* (1944), *Theory of Games and Economic Behavior*, which is best known for yielding the necessary and sufficient conditions under which expected utility theory holds; and Robert Kuenne of *Isard & Kuenne* (1953), "The Impact of Steel upon the Greater New York-Philadelphia Industrial Region," an early application of I-O analysis for measuring economic impacts.

His 1961 dissertation was published by the MIT Press in 1963 as *Domestic Airline Efficiency: An Application of Linear Programming*. It should be no surprise then that Ron's career focused on mathematical economic modeling.



In 1962, Ronald E. Miller, Ph.D., joined the newly formed Regional Science Department at the University of Pennsylvania, chaired then by Walter Isard. There Ron developed into a consummate teacher and professor, advising scores of graduate students, even receiving Penn's highest award for teaching in 1988. University-wide, his courses perennially ranked near the top in undergraduate student evaluation scores. Ron's lectures were as clear and crisp as his writing. His basic I-O course was required for both graduate and undergraduates in Penn's Regional Science Department. Lecture notes from these classes as well as from an advanced "topics in I-O analysis" seminar later culminated into early chapters of *Input-Output Analysis: Foundations and Extensions*, after Peter Blair joined the Department's faculty in the mid-1970s. And, while he sometimes seemed over-deliberate when writing out equations, Ron's meticulousness with respect to array conformability was a set of lessons patently relayed. This went for his other courses on mathematical programming as well. Ronald E. Miller was promoted to Professor Emeritus status in 1995.



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# INTERNATIONAL INPUT-OUTPUT ASSOCIATION

## In memoriam

Professor Miller authored and co-authored scores of articles as well as five books beyond his well-known tome with Peter Blair, and edited two volumes. After publishing his dissertation, Ron refocused his attention on measuring interregional feedback effects in multiregional I-O models, the earliest of which are still widely cited today. The earliest of these works are still widely cited today for their development of a technique called “hypothetical extraction,” the first of which (1963) corrected some equations in a salient piece by Professor Leon Moses then at Harvard University.

Professor Ronald E. Miller’s long, productive career was recognized by the North American Regional Science Council’s David Boyce Award for Service in 1995 and Walter Isard Award for Scholarly Achievement in 2006. He was elected a Fellow of the Regional Science Association International as well as of the International Input-Output Association. Less well-known to the wider academic community is Ron’s service to Penn and its Department of Regional Science. He twice served as the Department’s chair and chaired the graduate degree program. He also frequently was the Department’s representative on various university-wide committees and senates over the years.

Ron’s broad knowledge and careful editorial eye will be sorely missed by those who knew him best. He was frequently a willing reviewer of manuscripts and an occasional book reviewer. Ron was also known by colleagues and students for his tidy and organized office and with rare exceptions keeping an immaculate desktop. This led his somewhat less orderly, but very close, colleague Benjamin H. Stevens to assert publicly that “Ron’s so neat he keeps his telephone in a drawer.” When queried about this later, Ron chuckled, replying that just prior to Ben’s weekly arrival to his office Ron made sure to tuck the telephone in his desk.

This one story is a substitute for many others to recognize that, above all else, Professor Ronald E. Miller’s humor and wit will be remembered fondly. It was often snarky and biting a times but was always delivered with a smile and twinkling eyes and in a gentlemanly manner.

### **Books Authored or Coauthored.**

*Domestic Airline Efficiency: An Application of Linear Programming.* Cambridge, MA: The MIT Press, 1963.

(with David Sawers) *The Technical Development of Modern Aviation.* London: Routledge and Kegan Paul, 1968, and New York: Praeger Publishers, 1970.

*Modern Mathematical Methods for Economics and Business.* New York: Holt, Rinehart, and Winston, 1972. Reprinted, with corrections and a Solutions Manual, Huntington, NY: Krieger, 1978.

*Dynamic Optimization and Economic Applications.* New York: McGraw-Hill, 1979.

(with Peter D. Blair) *Input-Output Analysis: Foundations and Extensions.* Englewood Cliffs, N.J.: Prentice-Hall, 1985. Substantially revised in both 2009 (2nd ed.) and 2022 (3rd ed.) with Cambridge, U.K.: Cambridge University Press.

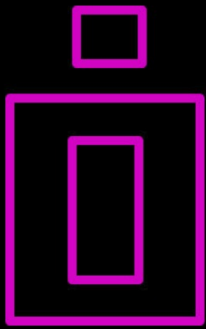
*Optimization: Foundations and Applications.* New York: John Wiley and Sons, Inc., 2000.

### **Edited Volumes.**

(with Karen R. Polenske and Adam Z. Rose) *Frontiers of Input-Output Analysis.* New York: Oxford University Press, 1989.

(with Michael L. Lahr) *Regional Science Perspectives in Economics: A Festschrift in Memory of Benjamin H. Stevens.* Contributions to Economic Analysis, No. 249. Amsterdam: North-Holland (Elsevier Science), 2001.





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# INTERNATIONAL INPUT-OUTPUT ASSOCIATION

## In memoriam

### Graham Pyatt (1936-2023)

Graham Pyatt, who died on February 4 2023 after a long period of ill health, made outstanding contributions in several fields of economics, including social accounting, input-output analysis, economy-wide policy modelling and income distribution and poverty analysis, although he will probably be best remembered for his work on social accounting matrices (SAMs) and their applications for development policy analysis. Graham received many awards: he was a Fellow of the Econometric Society, a Member of the International Statistical Institute, and a Fellow of the IIOA.

Born in Manchester (U.K.), Graham studied at Manchester for a BA in Economics. He then studied in successive years at Chicago (MA) and Nuffield College, Oxford, before joining the Department of Applied Economics at Cambridge (1959-64) working primarily on the Cambridge Growth Project under the direction of Sir Richard Stone. Alongside this work he completed a PhD, later published as a book by CUP. This was a highly productive period for him. Then, at the very young age of 28, he was appointed Professor of Mathematical Economics at the new University of Warwick.

In 1974 Graham Pyatt was invited by Hollis Chenery, World Bank Vice President, to be Senior Adviser in the Development Research Centre (DRC). Chenery and the DRC were charged with implementing a research programme that responded to the challenges set out in McNamara's landmark 1973 Nairobi speech which had placed Poverty Reduction rather than Growth at centre stage of World Bank policies. Graham Pyatt was hired to help develop the necessary analytical and statistical underpinnings for this. Several initiatives followed.

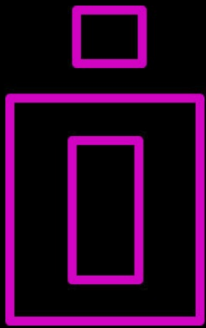
First, Graham developed further the SAM concept as an appropriate statistical framework for this purpose. Second, based on these SAMs, he helped to develop CGE and similar modelling techniques, alongside multiplier analysis, for policy analysis.



Thirdly, he helped to initiate the Living Standards Measurement Study (LSMS). This was an early multi-purpose, multi-dimensional household survey capability, designed to help monitor the effects of development policies on the poor. Many publications have ensued from all this work.

Graham Pyatt returned to Warwick in 1987 as Coopers and Lybrand Research Professor in Economics until 1994 when he took up a chair at the Institute of Social Studies (ISS), The Hague. His many students, colleagues and collaborators will remember him as a warm and generous man and an inspirational teacher, supervisor and collaborator.

Jeffrey I. Round  
University of Warwick, UK



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# INTERNATIONAL INPUT-OUTPUT ASSOCIATION

## In memoriam

### Selected publications

Pyatt, G (1964) *Priority Patterns and the Demand for Consumer Goods*, Cambridge University Press, Cambridge.

Pyatt G, and A R Roe (with others) (1977) *Social Accounting for Development Planning: with special reference to Sri Lanka*, Cambridge University Press, Cambridge.

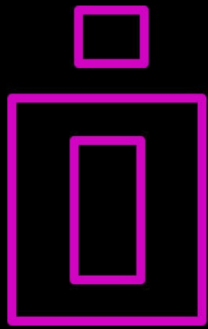
Pyatt G and J I Round (1979) 'Accounting and Fixed Price Multipliers in a Social Accounting Framework' *Economic Journal*, Vol 89, No 356, December, pp 850-73.

Pyatt, G and S Lahiri (1980) 'On the solution of scale-dependent input-output models' *Econometrica*, Vol 80, No 7, pp 1827-30.

Pyatt, G and J I Round (editors) (1985) *Social Accounting Matrices: A Basis for Planning*, World Bank, Washington DC.

Pyatt, G (2001) 'Some Early Multiplier Models and the Relationship with Production Structure', *Economic Systems Research*, Vol 13, Issue 2, pp 139-163.

Pyatt, G and J I Round (2010) 'Distribution Invariance and the Design of SAMs', *Economic Systems Research*, Vol 24, Issue 3, pp 251-273.



# INTERNATIONAL INPUT-OUTPUT ASSOCIATION

## Events

### SHAIO events



Dear colleagues:

The School of Economics, Business and Tourism (FEET) and the Department of Applied Economic Analysis (DAEA) of the University of Las Palmas de Gran Canaria (ULPGC) are pleased to invite you to participate in the **9th Permanent Workshop** of the Hispanic-American Society of Input-Output Analysis (SHAIO) to be held in **September 2023 in the city of Las Palmas de Gran Canaria, Spain**.



Despite being the ULPGC a young institution, there are several researchers within the Department of Applied Economic Analysis who have developed their research activity in the area of Input-Output analysis, both preparing impact models and participating in the preparation, adjustment and updating of Input-output Tables and Social Accounting Matrices. This is why, the confidence granted by the Society to organize the 9th Permanent Workshop in the city of Las Palmas de Gran Canaria is a great satisfaction for us.

There are two main objectives of this event. In the first place, it is intended to grant a special role to the work carried out by young researchers whose presentation will be valued by a senior researcher (discussant). The second objective is to increase the participation of researchers from Latin America. Being aware of the greater difficulties to participate in person in events held outside the American continent, the organization of the IX Permanent Workshop of SHAIO has decided to adopt an online session dedicated as a priority to the contributions of researchers from Latin America as well as everyone who may not be able to assist to the workshop in person. On the other hand, the organizing committee has planned the possibility of following all the sessions of the event online in the main room. The official languages of this event are Spanish and English. Abstracts and papers may be submitted in either of these two languages.

We are sure that the hospitality that characterizes our islands will offer, at the next meeting, the most favorable conditions to share and discuss our latest work. This ninth meeting is yet another example of the consolidation of these meetings, which have constantly and uninterruptedly given us the opportunity to collectively address all relevant issues on our research agenda.

Key Dates:

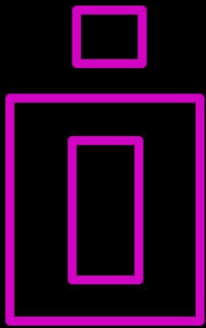
- **Abstract submission** → May 15, 2023
- **Notification of acceptance** → June 15, 2023
- **Full paper submission** → July 15, 2023
- **Registration deadline** → July 15, 2023
- **Workshop** → September 4-5, 2023

Please visit our website for more info:

<https://wio9.shaio.es/en/>

Looking forward to see you in Las Palmas de Gran Canaria!





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# INTERNATIONAL INPUT-OUTPUT ASSOCIATION

## Regional Research Institute Input-Output Archive



The Regional Research Institute at West Virginia University has a long history of involvement in IO research. Over the years, RRI amassed a substantial collection of IO related documents, including those of RRI researchers and documents donated to the Institute.

Prior to stepping down as director, I worked with RRI assistant Doris Berns to scan and curate electronic copies of these documents, which are now available in a permanent location at the [WVU Research Repository](#). For a listing of the available documents, click [here](#) to download a spreadsheet that lists titles of these documents. We hope that these documents will be useful to the IO research community.

Randall Jackson, Professor Emeritus

[Home](#) > [Regional Research Institute](#) > [RRI Input-Output Archive](#)

### RRI INPUT-OUTPUT ARCHIVE

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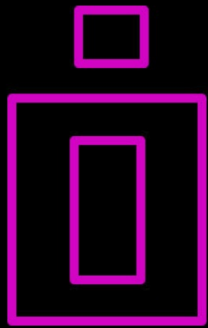
Browse the *RRI Input-Output Archive* Collections:

[Accounts and Data](#)

[Applications](#)

[Theory and Methods](#)

A	B	C	D	E	F	G
Category	Title	Study Location	Year Based On		For	By
Applications	The Structure of the Arizona E: Arizona		1958		Department of Agricultural Economics	Anilkumar G. Tjorhala, William E. Martin, Leonard G. Bower
Applications	The Economic Impact of the B: Australia		1979-1980		Comako Limited	R. C. Jensens, G. R. West
Applications	The South Carolina Economy: South Carolina		1958, 1961		Bureau of Business and Economic Research	Tredy T. Siz, Assistant Professor of Economics
Theory and Methods	Input-Output Analysis for Pra: United States					Goan R West
Theory and Methods	Regional Analysis: The Search for a Model of Intra-National Trade and Factor Mobility					Leon N. Moses
	Benchmark Input-Output Acco: United States		1992		U.S. Department of Commerce	United States Bureau of Economic Analysis
	The Detailed Input-Output Str: United States		1977		U.S. Department of Commerce	U.S. Bureau of Economic Analysis
	The Detailed Input-Output Str: United States		1977		U.S. Department of Commerce	U.S. Bureau of Economic Analysis
	The 1982 Benchmark Input-O: United States		1982		U.S. Department of Commerce, Bureau of Economic Analysis	
	Appendices to Regional Feder: United States		1963		U.S. Department of Commerce, Office of Economic Research	CONRAD Research Corporation
	Appendices to Regional Feder: United States		1963		U.S. Department of Commerce, Office of Economic Research	CONRAD Research Corporation
	Regional Federal Procurement United States		1963		U.S. Department of Commerce, Office of Economic Research	CONRAD Research Corporation
Theory and Methods	An Aggregate Income Model: Alaska		1960-1966		Federal Field Committee for Development Planning in Alaska	Bradford H. Tuck
Theory and Methods	Report I - Preliminary Analysis Appalachia				Office to Appalachian Studies, U.S. Army Corp of Engineers	
Theory and Methods	Report II - Technical Notes - Pv Appalachia				Office to Appalachian Studies, U.S. Army Corp of Engineers	
Accounts and Data	Report III - Direct Requirements Appalachia				Office to Appalachian Studies, U.S. Army Corp of Engineers	
Accounts and Data	Report IV: Direct and Indirect I Appalachia				Office to Appalachian Studies, U.S. Army Corp of Engineers	
Applications	An Analysis of the Economy of Arizona		1960		U.S. Department of the Interior Federal Water Pollution Control Admistr	Gilbert W. Bonem, John H. Chapman Jr., Dean Jansma, William H. Mierni
Applications	An Analysis of the Economy of Arizona		1960		U.S. Department of the Interior Federal Water Pollution Control Admistr	Gilbert W. Bonem, John H. Chapman Jr., William H. Mierni, Bernard U
Applications	An Analysis of the Economy of Arizona		1960		U.S. Department of the Interior Federal Water Pollution Control Admistr	Paul Barkley, Gilbert W. Bonem, John H. Chapman Jr., William H. Mierni
Accounts and Data	An Interregional Input-Output, Australia		1978-1979		Department of Commercial and Industrial Development	G. R. West, J. B. Morrison, R. C. JensenDepartment of Economics, Univer
Accounts and Data	Australian National Accounts I Australia		1977-1978		Australian Bureau of Statistics Canberra, Australia	R.J. Cameron
Accounts and Data	Australian National Accounts I Australia		1979-1979		Australian Bureau of Statistics Canberra, Australia	R. J. Cameron
Theory and Methods	Australian National Accounts I Australia					P. Grotton and P. Cotterell
Theory and Methods	Generation of Regional Input-4 Australia		73-74 & 76-77		Northern Territory Department of the Chief Minister	G. R. West, J. T. Wilkinson, R. C. Jensen



# INTERNATIONAL INPUT-OUTPUT ASSOCIATION

Published papers and books in Input-Output Analysis and related methods

## Economic Systems Research

Journal of the IIOA

Volume 34, Issue 4, 2022



### **Rossella Bardazzi & Leonardo Ghezzi**

[Large-scale multinational shocks and international trade: a non-zero-sum game](#)

International trade has improved living standards but has also become a major channel for spreading shocks on a global scale. The increasing relevance of intersectoral linkages and trade in intermediates renewed interest in input-output techniques. This paper enriches the literature on empirical trade models with an input-output/econometric approach including substitution effects and price spillovers. Our model shows that (a) trade elasticities and bilateral shares are not constant in time and differ across sectors and countries; (b) international price changes alter the relative competitiveness between competitors; (c) final demand components such as consumption and investment react to changes in international prices. Large multi-country shocks produce feedback effects in national economies as they adapt by import substitution across exporters, by changing the import content of domestic production and by adjusting final demand. These feedbacks affect the global demand producing an asymmetric non-zero-sum game.

### **Yoshihiro Hashiguchi, Norihiko Yamano & Colin Webb**

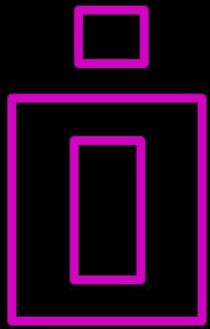
[How thick is your armour? Measuring economic resilience to shocks in global production networks](#)

When economic shocks occur, whether at home or abroad, economic agents are expected to react to reduce the negative impact or amplify the positive effects. The ability of a country to contain economic losses can be defined as the resilience to economic shocks. Using the OECD's annual Inter-Country Input-Output (ICIO) tables from 1995 to 2011, this paper investigates the relationship between changes in final demand and production structures for 61 economies. We found that, during economic downturns, countries that are able to prop up the economy through the domestic service sectors instead of domestic goods and foreign sectors are more resilient to negative shocks. Therefore, understanding the substitutability between goods and service sectors and between domestic and foreign sectors is crucial for gauging the potential risk to a country's domestic economy from shocks abroad – whether economic, environmental, health-related or political.

### **Timothé Beaufiglioli & Leonie Wenz**

[A scenario-based method for projecting multi-regional input-output tables](#)

Multi-regional input-output (MRIO) data are a powerful tool to analyze complex interdependencies in the international trade and supply network. Their field of application is however limited by the fact that MRIO datasets are only available for past years whereas the structure of the international trade network has been found to change profoundly over time. We here propose the SPIN method, a simple and flexible algorithm that can project MRIO tables into the future based on transparent scenarios of how gross domestic product and trade relations may evolve in that time. By combining well-established input-output techniques, namely the Leontief quantity model and an RAS-type algorithm, our method provides a straightforward mean to convert quantitative scenarios of the world economy into consistent MRIO tables. We illustrate the functioning of the SPIN method by projecting the evolution of the trade network after the 2008 financial crisis under different alternative scenarios of recovery.



# INTERNATIONAL INPUT-OUTPUT ASSOCIATION

**Timon Bohn, Steven Brakman & Erik Dietzenbacher**

**[Who's afraid of Virginia Wu? US employment footprints and self-sufficiency](#)**

Globalization has brought about concerns of domestic job losses due to outsourcing to countries like China. The 'employment footprint' concept provides new insights into the implications of trade for employment. Using this approach for the period of 1995–2008, we analyze the relation of US jobs with international trade, particularly with China. Furthermore, we compare the US employment footprint with its labor endowment to assess if the country could be self-sufficient in terms of labor. We find that the US's consumption increasingly depends on foreign workers. The country 'consumes' more labor than is nationally available; thus, self-sufficiency is not possible under realistic assumptions. Moreover, the US has benefited from jobs – especially in services – generated by the world economy. Referring to Albee's famous play about living in illusions, we use 'Virginia Wu' as a Chinese version of 'Virginia Woolf' to argue that the perceived threat of China (Virginia Wu) is only an illusion.

**Arndt Feuerbacher, Scott McDonald & Karen Thierfelder**

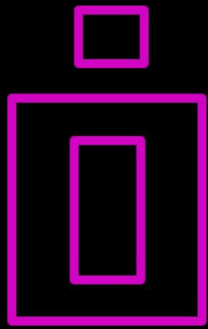
**[Peasant farmers and pandemics: the role of seasonality and labor-leisure trade-off decisions in economy-wide models](#)**

Pandemics attack the primary asset (labor) of peasant households and the rural poor. Peasant households must simultaneously allocate labor between farm and household activities, where the demand for agricultural labor is seasonal, which limits intra-temporal substitution, without perfect foresight. A pandemic reduces the supply of labor, through deaths and morbidity, with the scale of reductions in labor supply depending on the seasons in which a pandemic occurs. The analyses, using a recursive dynamic economy-wide model for Bhutan, demonstrate that outbreaks in high labor demand seasons cause increases in wage rates almost three times as high as for outbreaks in low labor demand seasons. Increases in wage rates induce peasant households to reallocate labor time between farm and household activities through the labor-leisure trade-off mechanism. Such changes in the allocation of labor time are important elements of peasants' mitigation responses, and can reduce the negative economic implications of a pandemic.

**Heran Zheng, Johannes Többen, Erik Dietzenbacher, Daniel Moran, Jing Meng, Daoping Wang & Dabo Guan**

**[Entropy-based Chinese city-level MRIO table framework](#)**

Cities are pivotal hubs of socioeconomic activities, and consumption in cities contributes to global environmental pressures. Compiling city-level multi-regional input-output (MRIO) tables is challenging due to the scarcity of city-level data. Here we propose an entropy-based framework to construct city-level MRIO tables. We demonstrate the new construction method and present an analysis of the carbon footprint of cities in China's Hebei province. A sensitivity analysis is conducted by introducing a weight reflecting the heterogeneity between city and province data, as an important source of uncertainty is the degree to which cities and provinces have an identical ratio of intermediate demand to total demand. We compare consumption-based emissions generated from the new MRIO to results of the MRIO based on individual city input-output tables. The findings reveal a large discrepancy in consumption-based emissions between the two MRIO tables but this is due to conflicting benchmark data used in the two tables.



# INTERNATIONAL INPUT-OUTPUT ASSOCIATION

## Latest ESR articles

### Economic Systems Research

Journal of the IIOA

Latest articles (up to 13<sup>th</sup> of Mar.)



**Jan Oosterhaven**

### Price re-interpretations of the basic IO quantity models result in the ultimate input-output equations

This note shows that Leontief's well-known demand-driven input-output (IO) quantity model may also be interpreted as the almost unknown revenue-pull IO price model, but measured in value terms instead of in prices. It is also shown how these two demand-driven models may be combined into a single ultimate demand-driven IO equation. An analogous result holds for the supply-driven quantity model and the cost-push price model, which results in a single ultimate supply-driven IO equation. The new price interpretation of the Leontief quantity model opens up hitherto unused possibilities to simulate interindustry demand-driven inflation processes, just as the price interpretation of the Ghosh quantity model enables simulations of supply-driven inflation processes.

**Alessandro Borin & Michele Mancini**

### Measuring what matters in value-added trade

The spread of global value chains (GVCs) has given rise to new statistical tools, the inter-country input-output tables, and new analytical frameworks aimed at properly identifying production linkages between and within economies. However, several important questions remain unaddressed. This paper proposes a new toolkit for value-added accounting of trade flows at the aggregate, bilateral, and sectoral levels. The paper shows how different empirical issues require distinct accounting perspectives and maps these methodologies onto the economic questions they are best suited to address. We provide novel accounting perspectives that allow us to properly address important empirical issues. With respect to other accounting methodologies previously proposed in the literature, we offer more accurate or, in some cases, more exhaustive value-added decompositions of trade flows (e.g. by covering both domestic and foreign value-added). In addition, the paper gathers a significant amount of the related literature under one comprehensive framework.

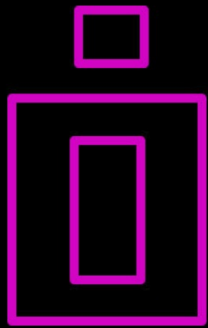
**Luis Tormo García, Paz Rico Belda, Francisco Morillas Jurado & Bernardí Cabrer-Borrás**

### A new approach to the hypothetical extraction method: regional full extraction

This paper proposes a generalisation of the regional extraction method used by Dietzenbacher et al. [(1993)]. The regional extraction method: EC input-output comparisons.

Economic System Research, 5(2), 185–206.  
<https://doi.org/10.1080/0953-5319300000017>].

The production system represented by an input-output table is broken down into three flow matrices: intermediate input, final demand, and value added. The approach of Dietzenbacher et al. [(1993)]. focuses on the input matrix to obtain both the backward and forward dependencies. The present paper, offers an alternative approach includes the final demand matrix to calculate the backward dependencies, while the value-added matrix is included for the forward dependencies. These two approaches are then compared by applying them to the empirical data based on the EUREGIO database. The results indicate that the Dietzenbacher et al. approach underestimates the dependencies, and the difference between these two approaches could lead to a different ranking of the dependence of the regions.



# INTERNATIONAL INPUT-OUTPUT ASSOCIATION

Maik Budzinski, Richard Wood, Behnam Zakeri,  
Volker Krey & Anders Hammer Strømman

[Coupling energy system models with multi-regional input-output models based on the make and use framework – insights from MESSAGEix and EXIOBASE](#)

Technology-rich integrated assessment models (IAMs) provide high resolution of the energy-related climate impacts, when exploring prospective climate change mitigation strategies. However, energy system models (ESMs), the core of integrated assessment models, usually ignore industrial linkages other than those related to energy. Furthermore, these models focus on climate change and neglect other environmental pressures. In this manuscript we present an approach for coupling ESMs with multi-regional input-output models (MRIOs) based on the Make and Use framework. The main advantage of using the Make and Use framework can be seen in improving both models simultaneously. An exemplary case study is carried out for the energy system model of MESSAGEix and the multi-regional input-output database of EXIOBASE. We further elaborate on the methodology to illustrate the usefulness but also challenges of this approach. Finally, we identify further steps to be carried out toward systematic prospective analyzes.

Ruoqi Li, Wenjun Wu, Wei Zhang, Yuanchun Zhou, Hongqiang Jiang, Yaling Lu, Cuiyang Feng, Jinnan Wang, Miaomiao Liu, Jun Bi, Yu Liu, Hongkuan Zang & Yuli Shan

[Managing lead \(Pb\) emissions in China from the perspective of final demand](#)

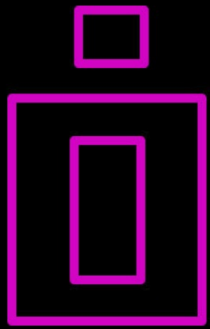
Lead (Pb) pollution is a serious environmental and health risk and remains a major challenge for China. This study analyzes China's atmospheric Pb emissions from the dual perspectives of production and final demand, by integrating localized emission factors and a Multi-Regional Input – Output model. Our results show that Shandong, Hebei, and Hubei directly contribute over 36% of the national emissions. However, from the final demand perspective, some developed provinces, such as Jiangsu, Guangdong, and Zhejiang, induce a considerable proportion (29%) of the national emissions by relocating emissions to other provinces through inter-provincial trade. Trade-embodied emissions typically flow from interior regions to more affluent coastal regions (e.g. Henan-Jiangsu, Anhui-Jiangsu, Hunan-Guangdong). Considering both production and final demand, we identify different roles for provinces in Pb emission management. Prosperous beneficiary provinces should take more responsibilities by transferring advanced technologies, especially those in industries such as coal dressing, to sacrificial provinces.

Louis de Mesnard

[Input-output price indexes: forgoing the Leontief and Ghosh models](#)

In input-output analysis, the Leontief and Ghosh models can be used to determine the price indexes of goods, which is convenient for analyzing inter-industry inflation. Their respective merits are debated, but both provide the same solution. We demonstrate that, contrary to common belief, it is superfluous to use the Leontief or Ghosh model to calculate price indexes: the price index vector alone satisfies the accounting identities without assuming constant coefficients. So, in contrast to the Leontief and Ghosh models, price indexes can be derived 'instantly', without a round-by-round process. Conducting research on price indexes deduce from the Leontief or Ghosh model becomes pointless: it suffices to study price indexes deduced from the data. We illustrate these findings with an application for France 2018. The same is demonstrated for prices with the data given in physical quantities.





# INTERNATIONAL INPUT-OUTPUT ASSOCIATION

**Timothé Beaufigli, Etienne Berthet, Hauke Ward  
& Leonie Wenz**

**[Beyond production and consumption: using throughflows to untangle the virtual trade of externalities](#)**

Understanding how countries contribute to the generation of externalities globally is important for designing sustainable policies aimed at reducing negative externalities such as carbon emissions. Commonly used approaches focus on either producers or consumers, thereby neglecting the role of intermediates. We here introduce the concept of throughflow to comprehensively quantify upstream externalities generated by the supply chains originating from, passing through or ending in a given country. We define the Throughflow Based Accounting (TBA) framework as the decomposition of the throughflow into local, imported, exported and traversing externalities. We illustrate the strength of the TBA by identifying the CO<sub>2</sub> emissions caused by supply chains involving the German economy. We show that Germany could use its position in global value chains to help reduce two times more CO<sub>2</sub> emissions than measured with usual production- or consumption-based accounting frameworks.

**Ershad Ostadzadeh, Amin Elshorbagy, Marta Tuninetti, Francesco Laio & Ahmed Abdelkader**

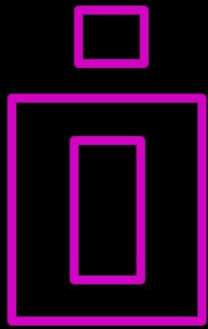
**[Who will dominate the global fossil fuel trade?](#)**

Fossil fuels are not distributed evenly throughout the world, and hence the countries rely heavily on international trade to secure energy supply. Characterization of the energy trade network is needed to conduct long-term assessments of energy security. This study proposes a modeling framework to assess the evolution of energy trade under current conditions as well as under future scenarios up to 2050. The total trade of each country is estimated with trade predictive models (TPMs) using key variables. Subsequently, a matrix-balancing method (RAS) is used to estimate the annual bilateral trades. The projected energy trade network in 2050 varies under each shared socioeconomic pathway (SSP) of the future, with annual fossil fuel global trades among countries ranging between 538 and 215 EJ. Canada, USA, Venezuela, and China are projected to dominate the global trade network, with Canada-USA remaining the most dominant fossil fuel trade link up to 2050.

**Claudio Socci, Marcello Signorelli, Silvia D'Andrea, Stefano Deriu & Francesca Severini**

**[The three plans by Biden: effects on economic growth and income inequality](#)**

The three budgetary plans under Biden's presidency—the American Rescue Plan, the American Families Plan, and the American Job Plan—encompass a set of measures meant to expand investments, support production processes, stimulate private consumption, and protect the labor market through transfers, tax credits, production subsidies, and federal unemployment benefits. Thus, besides relieving the economic system, these plans aim to drastically reduce poverty. This study attempts to disentangle the direct, indirect, and induced economic effects generated by these plans in a well-defined time-lapse through a dynamic computable general equilibrium model based on the social accounting matrix for the US. This approach enables the simulation of shocks from both the demand and supply sides, as well as policies for income redistribution. The simulation scenarios' results prove the plans' effectiveness vis-à-vis economic growth and support to households, as well as the peculiar effects on income inequality.



**Newsletter**  
Number 55, February 2023

# INTERNATIONAL INPUT-OUTPUT ASSOCIATION

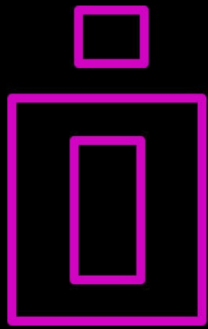
**Fernando de la Torre Cuevas, Xesús Pereira & Edelmiro López-Iglesias**

**[A new alternative for matrix balancing under conflicting information](#)**

Balancing input-output tables using iterative proportional fitting techniques can be prevented due to conflicting information. What is to be done in such cases? Literature suggests a wide variety of alternative methods. Within iterative proportional fitting techniques, modifying the constraint set to circumvent conflicting information problems has been suggested as a promising avenue. Following this approach, we identify some opportunities for improvement not yet been addressed. As a result of this research, we present an iterative proportional fitting variant. Our algorithm uses information contained in the matrix to be balanced for dynamically modifying our constraint set. We ensure economically meaningful solutions, avoiding unsought sign flips. We also respect all macroeconomic aggregates. To illustrate our findings, we provide an empirical example based on the supply-use tables for the region of Galicia (Northwest Spain). Results suggest that our methodological proposal can yield estimates almost as accurate as other alternatives while avoiding undesired outcomes.

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# INTERNATIONAL INPUT-OUTPUT ASSOCIATION

## Highlights in journals

**Fiona H. M. Tang, Arunima Malik, Mengyu Li, Manfred Lenzen & Federico Maggi**

**[International demand for food and services drives environmental footprints of pesticide use](#)**

*Communications Earth & Environment volume*

Pesticides are well-recognised pollutants that threaten biodiversity and ecosystem functioning. Here we quantify the environmental footprints of pesticide use for 82 countries and territories and eight broad regions using top-down multi-region input-output analysis. Pesticide footprints are expressed as hazard loads that quantify the body weight (bw) of non-target organisms required to absorb pesticide residues without experiencing adverse effects. We show that the world's consumption in 2015 resulted in 2 Gt-bw of pesticide footprints. Of these, 32% are traded internationally. The global average per-capita pesticide footprint is 0.27 t-bw capita<sup>-1</sup> y<sup>-1</sup>, with high-income countries having the largest per-capita footprint. China, Germany, and United Kingdom are the top three net importers of pesticide hazard loads embodied in commodities, while the USA, Brazil, and Spain are the three largest net exporters. Our study highlights the need for policies to target pesticide use reduction while ensuring adverse impacts are not transferred to other nations.

**Arunima Malik, Mengyu Li, Manfred Lenzen, Jacob Fry, Navoda Liyanapathirana, Kathleen Beyer, Sinead Boylan, Amanda Lee, David Raubenheimer, Arne Geschke & Mikhail Prokopenko**

**[Impacts of climate change and extreme weather on food supply chains cascade across sectors and regions in Australia](#)**

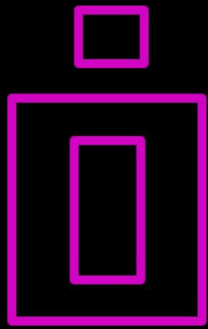
*Nature Food*

Disasters resulting from climate change and extreme weather events adversely impact crop and livestock production. While the direct impacts of these events on productivity are generally well known, the indirect supply-chain repercussions (spillovers) are still unclear. Here, applying an integrated modelling framework that considers economic and physical factors, we estimate spillovers in terms of social impacts (for example, loss of job and income) and health impacts (for example, nutrient availability and diet quality) resulting from disruptions in food supply chains, which cascade across regions and sectors. Our results demonstrate that post-disaster impacts are wide-ranging and diverse owing to the interconnected nature of supply chains. We find that fruit, vegetable and livestock sectors are the most affected, with effects flowing on to other non-food production sectors such as transport services. The ability to cope with disasters is determined by socio-demographic characteristics, with communities in rural areas being most affected.

**Junna Yan, Yingzhu Li, Bin Su & Tsan Sheng Ng**  
**[Contributors and drivers of Chinese energy use and intensity from regional and demand perspectives, 2012-2015-2017](#)**

*Energy Economics*

China has been experiencing significant energy use transition accompanied by emphasizing on dual control of energy (e.g. energy consumption and energy intensity). Energy use was expected to present obvious spatial characteristics and differentiated contributions across regions. A systematic energy analysis was carried out to 31 regions (including Tibet) in China for investigating the contributors to national achievements and key drivers of regional energy use. With the help of multi-region input-output model (MRIO) and structural decomposition analysis (SDA) techniques, we found that the aggregate energy use in China has been advanced effectively with a declined increasing total energy consumption and accelerated decreasing total aggregate energy intensity. From regional perspective, Eastern region contributed the most characterized by greater total embodied energy consumption and lower aggregate embodied energy intensity, such as Shandong, Hebei and Jiangsu. From demand perspective, regional energy use has been dramatically determined by investment, consumption and exports in sequence. The changes in regional energy use have been tremendously influenced by the sectoral energy intensity and domestic production structure with differentiated performance across regions. According to additive and multiplicative SDA results, two different regional energy conservation paths, i.e. efficiency- and structure-oriented improvements, were identified for China.



# INTERNATIONAL INPUT-OUTPUT ASSOCIATION

**Xiaoyong Zhou, Ye Hang, Dequn Zhou, B.W. Ang,  
Qunwei Wang, Bin Su & Peng Zhou**

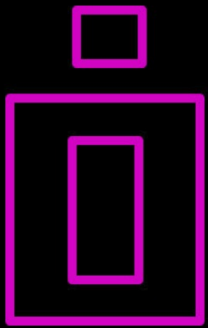
**Carbon-economic inequality in global ICT trade**  
*iScience*

The expansion of information and communications technology (ICT) trade has contributed to rising trade imbalances and international tensions. A detailed assessment of the potential carbon and economic impacts of ICT trade is pertinent. We assess to what extent and how the carbon costs and economic benefits embodied in ICT trade were unevenly distributed among global regions in the period 2000–2018 using multiregional input-output models. We show that in 2018, emerging economies received 82% of the CO<sub>2</sub> emissions while developed economies gained 42% of the value-added in ICT exports. This carbon-economic inequality (CEI) decreased (i.e., improved) by 16% from 2000 to 2018, arising from global production fragmentation, with developed economies retaining downstream high value-added ICT marketing but outsourcing upper- and middle-stream carbon-intensive material extraction and manufacturing to emerging economies. This study provides insights for enhancing negotiations and cooperation among global regions to light a path toward sustainable ICT trade.

**Tasos Kitsos, Simone Maria Grabner & André Carrascal-Incera**

**Industrial Embeddedness and Regional Economic Resistance in Europe**  
*Economic Geography*

We study the role of local industrial embeddedness (the share of regional interindustry economic activity that is anchored to a region) on regional resistance (the difference between pre- and postcrisis employment) to the 2008 Great Recession (GR) in EU and UK NUTS-2 regions. The recession had profound effects in regional economies, which showed diverse performance based on their capacity to absorb the shock. The concept of economic resilience has been brought to the center of attention with several contributions exploring its determinants. However, the impact of the embeddedness of local economic systems in terms of sales and supplies has been largely unexplored. We use regional input-output tables to approximate the embeddedness of local economies, and we use fixed-effects and quantile regressions to test its relationship to regional resistance between 2008 and 2011. We find that during the GR, regional industries opted to change input rather than output markets. Additionally, embeddedness has a curvilinear relationship to regional resistance that varies across the distribution of regional resistance performance. Finally, at the industry level, we find regional embeddedness to be important to the resistance of manufacturing and financial and business services, and sectoral embeddedness to matter more for the resistance of construction and wholesale, retail, and information technology. Our findings highlight nuances that policy makers should be aware of in planning for resilience.



# INTERNATIONAL INPUT-OUTPUT ASSOCIATION

## Job Positions



### IonE Postdoctoral Fellowship Program at Univ. of Minnesota



**Did you earn a PhD in any area with sustainability focus or about to defend?** Do you believe in a future where people and the planet prosper together? Do you believe in interdisciplinary academic research, community-engaged scholarship, and interested in solutions-oriented research to support equitable and just sustainability transition for all? If yes! We need you at the [Institute on the Environment](#) (IonE).

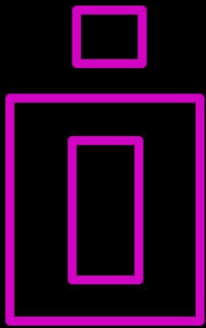
The IonE is accepting applications for launching a cohort-based [Postdoctoral Fellowship Program](#). We anticipate having an annual cohort of 5-10 fellows every year. Each Fellow will receive a postdoctoral fellowship **salary commensurate with experience between \$60,000-\$68,500**; additionally they will receive research and professional expenses, moving expenses, as well as [benefits](#), including health care coverage and paid leave.

The goal of the IonE Postdoctoral Fellowship is to accelerate the transition to a sustainable future by supporting breakthrough research across disciplines, developing the next generation of global leaders, and building transformative partnerships across the state, region and globe. IonE Postdoctoral Fellows will lead 1-2 projects during their tenure. You can view the IonE projects [here](#).

You can apply now, [learn more](#) and visit the IonE Postdoctoral Fellowship webpage to submit your application ([z.umn.edu/ione-postdoc-fellows](http://z.umn.edu/ione-postdoc-fellows)). **Our application closes May 1, 2023.**







# INTERNATIONAL INPUT-OUTPUT ASSOCIATION

## The Social Accounting Corner

Questions: 1) How did you learn about Input-Output for the first time? Can you remember your first thoughts? 2) Which was your first IIOA conference? Any memory that you want/can share? 3) Recommend the readers of the newsletter a paper that surprised or inspired you.

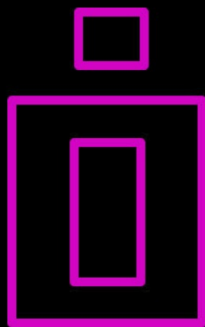
**Kenia Barreiro de Souza – Professor at  
Universidade Federal do Paraná (Brazil)**



1) I learned about Input-Output during college with Professor Fernando Perobelli. I don't exactly remember my first thoughts, but what always amazed me was how the whole economy could be synthesized in a single matrix, how easily it could be manipulated and how a good deal of information we could extract from it.

2) My first IIOA conference was in Seoul (2016), I got the travel grant, and it was an amazing experience. Everything was really new for me, it was the first time I traveled abroad for a conference, and the country was completely different from any place I had been before. When I arrived, I remember being deeply insecure, but everyone was really welcoming, and soon I felt all the energy and the astonishing academic environment of the conference.

3) A recent paper that surprised me was written by García-Alaminos et al., published in Economic System Research, in 2021. The title is “Reassembling social defragmented responsibilities: the indecent labour footprint of US multinational overseas”. The article estimates the indecent work embodied in US’s Multinational Corporations (MNEs) global value chains, using the concept of producer footprint (PF). By indecent work, the authors use three indicators on forced labour, fatal and non-fatal injuries. The result that surprised me the most was the potential of US’s Multinational Corporations to reduced indecent work in the world: “fatal injuries PF would be reduced by 50%, the nonfatal injuries PF would be decrease by 50%, and the forced labour PF would drop by 63% (p. 544)”.



# INTERNATIONAL INPUT-OUTPUT ASSOCIATION

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**Jorge Zafrilla – Professor of Economics at the Department of Economics and Finance – GEAR Research Group, University of Castilla-La Mancha (Spain)**



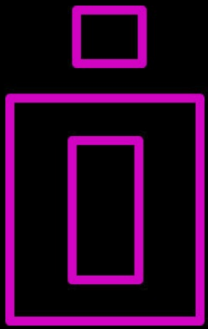
1) My first contact with input-output analysis was during my undergraduate studies. Unfortunately, at that time, the presence of this type of modeling in the curriculum was almost residual. After finishing my Bachelor's degree, in 2007, I was lucky enough to connect and start working in the Department of Economic Analysis at the University of Castilla-La Mancha (UCLM) in Albacete. It was there that I began to study and work in detail with this methodology for the very first time. Thanks to Professor Óscar Dejuán and his team, I was hired as a technician to develop a knowledge transfer contract for the Spanish National Energy Commission. This study proposed a model to predict the demand for energy goods for the Spanish economy in 2009-2012 under different scenarios. The proposed extended input-output model, explained in detail in Dejuán et al. (2013), which satisfied the institution's board, presented interwoven quantity and price models. The quantities model was based on the Keynesian effective demand principle. The price model was based on the classical Sraffian theory of output prices, akin to post-Keynesian full-cost prices. This methodological approach allowed me to learn about input-output analysis from a useful, applied, and unorthodox perspective.

Additionally, that energy extension opened and laid the foundations for the existence and *raison d'être* of the [GEAR group](#) to which I have belonged ever since. This approach allowed the GEAR research group to consolidate its position in the international sphere in areas closely linked to environmental studies and social and economic impacts along global production chains.

Dejuán, Ó., López, L.A., Tobarra, M.Á., Zafrilla, J., 2013. A Post-Keynesian Age Model To Forecast Energy Demand In Spain. *Economic Systems Research* 25, 321-340.

2) My first IIOA conference was Seville in 2008, which I attended at the invitation of my research group as a result of the project for which I was hired in the first instance. My memories are related to the luxury of putting a face to and meeting those colleagues whose work I had been studying and quoting since the end of my studies. In addition, it meant meeting in person with the Spanish and Latin American input-output community with which, in the following years, we have strengthened deep ties of collaboration and joint work through the Hispanic-American Input-Output Society (SHAIO).

However, when I think of other IIOA events, it is impossible not to highlight the experiences I lived in Lisbon in 2014, an event in which I was able to participate in the novel, at that time, flash sessions. Mexico City in 2015, a conference where we presented our first prolific research on multinational companies' role and environmental impact along global production chains. Atlantic City 2017, where, among other great memories, we enjoyed, for the first time, the excellent Young Researchers Night initiative. Or, finally, Glasgow 2019, one of the best IIOA conferences in which I have participated and where we were able to present some of our most ambitious lines. Many excellent memories on a list that I only hope to extend in Alghero.



# INTERNATIONAL INPUT-OUTPUT ASSOCIATION

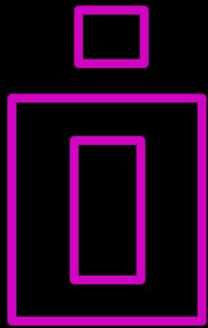
## The Social Accounting Corner

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3) Leaving aside the main contributions to input-output analysis that laid the foundations of what it is today, I would like to highlight a series of works that were key to the future of the GEAR research group. As I said at the beginning, since 2008, the group has specialized in the proposal of environmental and energy extensions and, above all, joined the then-new debate on the different potential criteria for accounting for greenhouse gas emissions responsibilities. If I had to highlight the works that have influenced the most my training and my consolidation as a researcher, I would undoubtedly name the following: the contributions on producer and consumer responsibility by Peters (2008) and Davis and Kaldeira (2010); the study of the different impacts of household consumption in terms of carbon footprint, highlighting, among others, the paper by Weber and Matthews (2009); or the descent to the company level with hybrid modeling that sought to measure the environmental impact of corporations along their supply chain with the pioneering work of Wiedmann et al. (2009). And derived from the needs and issues identified by these contributions, I cannot fail to highlight the value of the development of rigorous multiregional databases that began to flood our hard disks with megabytes. The emergence of these multiregional databases undoubtedly allowed us to raise input-output analysis to levels of usefulness unthinkable decades ago and to extend its uses and applications to a myriad of purposes.

In this sense, it is worth highlighting the 2013 special issue in Economic Systems Research about the moment we were living in terms of multiregional databases and their possibilities; I refer to WIOD, EORA, EXIOPOL, the former EXIOBASE, GTAP-MRIO or IDE-JETRO (Tukker and Dietzenbacher, 2013). Maybe it is time to launch a new special issue. Many of these projects have only grown (WIOD, EXIOBASE, or GLORIA, among others), and many others have joined (FIGARO, ICIO, ICIO-AMNE, or EMERGING, among others) to nourish our scientific proposals with reliable and rigorous data.

- Peters, G.P., 2008. From production-based to consumption-based national emission inventories. *Ecological Economics* 65, 13-23.
- Weber, C.L., Matthews, H.S., 2008. Quantifying the global and distributional aspects of American households carbon footprint. *Ecological Economics* 66, 379-391.
- Wiedmann, T.O., Lenzen, M., Barrett, J.R., 2009. Companies on the Scale: Comparing and Benchmarking the Sustainability Performance of Businesses. *Journal of Industrial Ecology* 13.
- Davis, S.J., Caldeira, K., 2010. Consumption-based accounting of CO<sub>2</sub> emissions. *Proc Natl Acad Sci* 107, 5687-5692.
- Tukker, A., Dietzenbacher, E., 2013. Global multiregional input-output frameworks: An introduction and outlook. *Economic Systems Research* 25, 1-19.



# INTERNATIONAL INPUT-OUTPUT ASSOCIATION

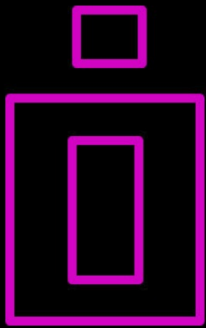
## Word Search

This is a word search puzzle; a word game that consists of the letters of words placed in a grid. The objective of this puzzle is to find and mark all the words hidden inside the box. A list of words in the puzzle is to right of the grid.

Michael L. Lahr



- |               |               |            |             |
|---------------|---------------|------------|-------------|
| Account       | Export        | Leontief   | Resource    |
| Aggregate     | Extended      | Linkage    | Sattelite   |
| Average       | Fixed         | Loop       | Singular    |
| Blair         | Gravity       | Make       | Slack       |
| Carbon        | Growth        | Material   | SNA         |
| Cell          | Holistic      | Matrix     | Stone       |
| Climate       | Identity      | Measure    | Structure   |
| Data          | Import        | Model      | Supply      |
| Decomposition | Indirect      | Multiplier | Symmetric   |
| Deflation     | Input         | National   | System      |
| Demand        | Interest      | Output     | Tax         |
| Determinant   | Interindustry | Partition  | Technology  |
| Element       | Interregional | Pollution  | Transaction |
| Energy        | Inverse       | Prices     | Triangular  |
| Environment   | Investment    | Program    | Use         |
| Equilibrium   | Iteration     | Pyatt      | Value       |
| Excess        | Kuroda        | Rent       |             |



# INTERNATIONAL INPUT-OUTPUT ASSOCIATION

**Solution to  
 The Holiday  
 Acrostics**

Michael L. Lahr

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A	74	33	46	122	144	103	61		
B	102	34	75	22	25	48	27		
C	106	136	13	64	113				
D	146	123	16	79					
E	2	89	7	134	60	47			
F	69	88	8	37	31	138	1	130	105
G	41	120	17	73	56				
H	15	58	90	45	119	128	94		
I	76	132	110	117	141				
J	77	65	91	127	137	50			
K	86	54	10	51					
L	104	62	114	24	126	41	87	93	
M	64	30	70	4	140	42	23		
N	135	55	85	29	108	112	145	95	
O	35	109	97	116					
P	115	98	21	52	81	133	111		
Q	9	72	38	26	82	53			
R	67	19	6	96	83				
S	36	92	3	68	118	126			
T	28	142	59	101	139	57	129		
U	63	39	14	18	121				
V	124	40	11	80	20				
W	71	131	99	100	43	12			
X	143	5	78	66	49	32	107		