In this issue

OECD

Coming soon!!!
New Inter-Country Input-Output (ICIO) tables and updated TiVA results

In memoriam

Ambica K. Ghosh (1921-2014)

Eminent Professor of Economics at Jadavpur University, Kolkata, India, Professor Ambica Prosad Ghosh passed away on October 2, 2014, at his home in Kolkata. His family, colleagues and students paid homage on October 19 to the great soul, who had stimulated more than two generations of dedicated students and lead input-output (I-O) science into new directions of excellence.

Prof. Ghosh was born in 1921 to Nagendranath Ghosh and Usha Ghosh in his ancestral home in Kolkata. He graduated with honours in English from Scottish Church College, Kolkata. He then obtained Master's Degree in English from the University of Calcutta, where he later completed a second Masters in Economics as well as his Ph.D., which was capped with a dissertation entitled "Land Reform in West Bengal." He subsequently focussed on I-O research in which he excelled. The importance of his contributions to the field of I-O parallels those of two stalwarts in the field, viz, Prof. Wassily Leontief of Harvard University and Prof. Richard Stone of Cambridge University. The three were close both professionally and personally, and undertook many activities together. Many present eminent scholars—e.g., Professor Erik Dietzenbacher—have or continue to examine and use the Ghosh model and the Ghosh inverse. In this vein, Prof. Ghosh contribution endures.

Professor Ghosh's academic career started at the Indian Statistical Institute, Kolkata. After five years in England at the London School of Economics and Cambridge University, he returned to India and joined

Jadavpur University in 1959. He travelled extensively and worked on different assignments for the United Nations in Bangkok, Teheran and other countries. He was a Visiting Professor at Harvard University during the 1961-1962 school year.

During his tenure at Jadavpur University, he was the Dean of the Faculty of Arts and was the acting Vice-Chancellor for a short period. Prof. Ghosh retired from the university as a Senior Professor when he was 65 years old. Nevertheless, he continued his
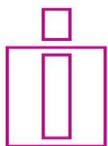
research apace. Prof. Ghosh was a very effective research guide and provided support to a large number of Ph.D. students. His students, who are spread across India and other countries, hope to emulate his interest and energy in I-O research.

In his personal life he was a follower of the Marxist philosophy and, during his student life, followed the communist party movement. Still, his political inclination never came between him and his students.

His personal life style was simple. He loved to say "Go forward; don't stop"—a mantra for his students of all ages and nationalities.

Prof. Ghosh is survived by his son and daughter. His son is Professor of Physics at the Indian Statistical Institute, Kolkata and daughter is a Professor of Physics at Jadavpur University. Kolkata.

His students and followers

I was inducted into the world of interindustry economics at an early state of my life by Prof. Ghosh. He taught us the various levels of this analysis during both our bachelors and masters courses at Jadavpur University. Later on I was very keen to be his Ph.D. student and was ultimately his last one in 1984. His acceptance of me as a Ph.D. advisee pleased me to no end since he also advised several other scholars who people my age admired because of their dedication to the field. One such person was Prof. Debesh Chakraborty. To all of his students, Prof. Ghosh exemplified the roles of a teacher, a mentor, a guide, a philosopher, and a friend in the truest of senses! He also introduced many of us to the international economics community working in our area of interest. He encouraged many of us to present papers at the 1986 International Conference on Input-Output Techniques at Sapporo. Indeed, Prof. Ghosh opened our eyes and encouraged us to aspire to understand the full scope of the I-O world!

Anushree Sinha
Senior Fellow, NCAER

It is with great sadness that I read the news that Professor Ambica Ghosh passed away. The input-output community (and the Indian I-O community in particular) has lost a great scientist. His 1958 *Economica* paper on the allocation of goods has become a true classic. Only few scholars have their name attached to a model or theory, and Professor Ghosh was one of them. Everyone in the input-output community knows about the Ghosh model and the Ghosh inverse. The model is highly original and (like the input-output model itself) strikingly simple. The model was published in 1958 and led to a very lively debate in the late 1980s. Several scholars tried to frame Professor Ghosh's original idea in a standard production framework. This perspective failed, which led to an opinion that the model was implausible.

I add a more personal footnote to this story; that is, it was (and remains) my pleasure to resolve the puzzle. In essence, a slightly different interpretation of the model's inherent economics enables the implausibilities to vanish. Thus, the Ghosh model more or less regained its viability.

Unfortunately, I never had the chance to meet Professor Ghosh. I would have loved to discuss these issues with him. I was very flattered though when I heard (from one of our mutual colleagues) that Professor Ghosh was pleased with my contribution.

Today is a very sad and rainy day. My deepest condolences go to his family, friends, colleagues, and former students. I wish them all much strength and peace as they deal with his passing.

Erik Dietzenbacher, President of the IIOA

46 years of Danish IOTs now converted to SNA08/ESA2010

STATISTICS DENMARK has finalized the conversion of the Danish National Accounts to the SNA08/ESA2010 framework. Very detailed SUTs have been compiled for 2005-2011 and new IOTs have been compiled for the same years. However, the time series of annual IOTs in current and previous years prices 1966-2004 has been updated as well in order to implement the revision here also and to maintain the consistency over time in the series. Data can be downloaded in Excel, SAS, GAMS, and GAUSS format.
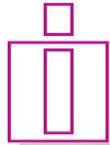
Published papers and books in IOA and related methods

Latest ESR articles

Economic Systems Research

Journal of the IIOA

Latest articles (up to 1 Nov. 2014)

ASSESSING THE IMPACT OF DISTRIBUTIVE POLICIES ON THE BRAZILIAN ECONOMY USING AN SCGE MODEL. MORRONE H.

This study investigates the impact of macroeconomic policies on the Brazilian economy. We present a two-sector, open-economy, Structuralist Computable General Equilibrium model that distinguishes among three economic classes and assumes no financial sector. The Social Accounting Matrix for Brazil in 2006 serves as a benchmark for our model. We compare the medium-run effects of five experiments: an income transfer towards formal workers, a transfer to informal labour, an investment shock, an exchange rate depreciation, and a policy mix that combines (exchange rate) depreciation with income transfer towards

modern (sector) workers. The policy measures reinforce each other in terms of their potential to enhance growth. Our findings underscore the importance of redistributive policies to foster economic expansion.

PROCESSING TRADE BIASES THE MEASUREMENT OF VERTICAL SPECIALIZATION IN CHINA. YANG C., DIETZENBACHER E., PEI J., CHEN X., ZHU K. and TANG Z.

Vertical specialization (VS) is often measured by the import contents of the exports, using an input-output (I-O) framework. Half of China's exports are processing exports, which largely depend on imported intermediate inputs and tie up upstream as well as downstream trade partners. Thus, one would expect to find strong VS for China. Using the ?ordinary? I-O tables, however, this is not the case. Because the production of processing exports is only a small part of total production, the average input structure in the I-O table hides the typical features of processing exports. Using adapted, tripartite I-O
tables (for 2002 and 2007) in which the processing exports have been singled out, indeed reveals the expected strong VS in China.

SUBSTITUTION ELASTICITIES IN A CONSTANT ELASTICITY OF SUBSTITUTION FRAMEWORK – EMPIRICAL ESTIMATES USING NONLINEAR LEAST SQUARES. KOESLER S. and SCHYMURA M.

Elasticities are key parameters for any economic analysis. Using the World-Input?Output Database, we estimate substitution elasticities for a three-level nested constant elasticity of substitution KLEM
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production structure using up to date nonlinear least squares estimation procedures. This allows us for the first time to use one coherent data set for the estimation process. Furthermore, it gives us the opportunity to derive elasticities from the same data which researchers can use to calibrate their models. On the basis of our estimations, we demonstrate that the practice of using Cobb-Douglas or Leontief production functions in economic models must be rejected for the majority of sectors. We provide a comprehensive set of estimated substitution elasticities covering a wide range of sectors. Our results suggest that no substantial change in input substitutability takes place during the time period we consider. Moreover, there is no substantial variation in substitution elasticities across regions

Highlights in journals

HOEKSTRA R., EDENS B., ZULT D. and WILTING H. (2014) REDUCING THE VARIATION OF ENVIRONMENTAL FOOTPRINT ESTIMATES BASED ON MULTIREGIONAL INPUT–OUTPUT DATABASES. SUSTAINABILITY ACCOUNTING, MANAGEMENT AND POLICY JOUR. 5(3):325-345

The purpose of this paper is to study reducing the variation of environmental footprint estimates based on multiregional input– output (MRIO) databases. Footprint estimates from various MRIO databases sometimes vary significantly. As a result, conclusions about the absolute levels or trends of a footprint may be inconsistent. The sources of these variations are attributable to
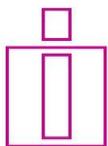
three phases in the footprint calculations: differences in data preparation, MRIO database construction and footprint calculation. This paper provides a literature overview and a breakdown of the computation of footprints based on MRIO database. Based on these insights, strategies that lead to lower variation in footprint estimates are formulated. Convergence of footprint estimates require enhanced cooperation amongst academics, among statisticians and between academics and statisticians. Reducing the variation in footprint estimates is a major challenge. This paper aims to contribute to this convergence in three ways. First, this paper provides the first overview of footprint work at statistical offices, government agencies and international organisations. These are the front-runners that may play a role in cooperating with academics (and other statistical offices) to resolve some of the issues. Second, a detailed analysis of the sources of the variation in estimates is provided. These problems are illustrated using examples from the various MRIO databases and the data of Statistics Netherlands. Third, strategies are discussed that might help reduce variation between footprint estimates.

SIMAS M.S., WOOD R. and HERTWICH E. (2014) LABOR EMBODIED IN TRADE: THE ROLE OF LABOR AND ENERGY PRODUCTIVITY AND IMPLICATIONS FOR GREENHOUSE GAS EMISSIONS. JOURNAL OF INDUSTRIAL ECOLOGY

Global production chains carry environmental and socioeconomic impacts embodied in each traded good and service. Even though labor and energy productivities tend to be higher for domestic production in high-income countries than those in emerging economies, this difference is significantly reduced for consumption, when including imported products to satisfy national demand. The analysis of socioeconomic and environmental aspects embodied in consumption can shed a light on the real level of productivity of an economy, as well as the effects of rising imports and offshoring. This research introduces a consumption-based metric for productivity, in which we evaluate the loss of productivity of developed nations resulting from imports from less-developed economies and offshoring of labor-intensive production. We measure the labor, energy, and greenhouse gas emissions footprints in the European Union's trade with the rest of the world through a multiregional input-output model. We confirm that the labor footprint of European imports is significantly higher than the one of exports, mainly from low-skilled, labor-intensive primary sectors. A high share of labor embodied in exports is commonly associated with low energy productivities in domestic industries. Hence, this reconfirms that the offshoring of production to cheaper and low-skilled, labor-abundant countries offsets, or even reverts, energy efficiency gains and climate-change mitigation actions in developed countries.

WEINZETTEL J., STEEN-OLSEN K., HERTWICH E. G., BORUCKE M. and GALLI A. (2014) ECOLOGICAL FOOTPRINT OF NATIONS: COMPARISON OF PROCESS ANALYSIS, AND STANDARD AND HYBRID MULTIREGIONAL INPUT–OUTPUT ANALYSIS. ECOLOGICAL ECONOMICS 101:115-126.

The ecological footprint (EF) is an indicator of human requirements on bio-productive land, an essential but limited resource, which use is related to environmental burden. In this article, we compare three methods for calculating national EF: a) the process analysis represented by Global Footprint Network (GFN) accounts; b) a standard environmentally extended multi-regional input–output model (EE-MRIOM); and c) a hybrid EE-MRIOM. The process analysis accounts for total domestic production and international trade of selected products. A standard EE-MRIOM further accounts for the upstream footprint of all traded products, but has a low resolution of relevant products in available datasets. The hybrid EE-MRIO method assessed here traces the primary biomass products in physical units through environmental extensions. Our results show that the standard MRIO model might introduce a significant error due to low resolution and poor data quality. The hybrid MRIO approach provides more accurate results than the standard MRIO method since it applies data from additional sources on a more detailed level. The process analysis underestimates the footprint of imports and exports as it ignores trade in services and other products as well as the upstream flows of products included in the analysis.

SIMAS M.S., GOLSTEJN L., HUIJBREGTS M.A.J., WOOD R. and HERTWICH E.G. (2014) THE "BAD LABOR" FOOTPRINT: QUANTIFYING THE SOCIAL IMPACTS OF GLOBALIZATION. SUSTAINAIBILITY 6(11):7514-7540.

The extent to what bad labor conditions across

the globe are associated with international trade is unknown. Here, we quantify the bad labor conditions associated with consumption in seven world regions, the "bad labor" footprint. In particular, we analyze how much occupational health damage, vulnerable employment, gender inequality, share of unskilled workers, child labor, and forced labor is associated with the production of internationally traded goods. Our results show that (i) as expected, there is a net flow of bad labor conditions from developing to developed regions; (ii) the production of exported goods in lower income regions contributes to more than half of the bad labor footprints caused by the wealthy lifestyles of affluent regions; (iii) exports from Asia constitute the largest global trade flow measured in the amount bad labor, while exports from Africa carry the largest burden of bad labor conditions per unit value traded and per unit of total labor required; and (IV) the trade of food products stands out in both volume and intensity of bad labor conditions

MAJEAU-BETTEZ G., WOOD R. and STRØMMAN A.H. (2014) UNIFIED THEORY OF ALLOCATIONS AND CONSTRUCTS IN LIFE CYCLE ASSESSMENT AND INPUT-OUTPUT ANALYSIS. JOURNAL OF INDUSTRIAL ECOLOGY 18(5):747-770.

The treatment of coproducts is one of the most persistent methodological challenges for both input-output (IO) analysis and life cycle assessment (LCA). The two fields have developed distinct modeling traditions to artificially extract independent Leontief production functions (technological "recipes") for products of multioutput activities; whereas IO operates in terms of system-wide models named constructs, LCA practitioners usually use allocations or system expansion on a process-by-process basis. Recently, there have been renewed efforts to connect these two modeling traditions on the basis of their underlying assumptions. A formal description of a unified framework for the treatment of coproducts is still lacking, however. The present article strives to fill this gap. From a single generalized allocation equation, we derive all practical LCA allocations and IO constructs. This approach extends previous studies by arranging the different models in a formal "taxonomic tree," clarifying the relation between the different LCA allocation and IO construct models. This framework also clarifies the relation of certain models to classical system expansion. We then analyze the properties of these models when combined with different types of inventories and make recommendations for best practice in inventory compilation.

MALIK A., LENZEN M., ELY R.N. and DIETZENBACHER E. (2014) SIMULATING THE IMPACT OF NEW INDUSTRIES ON THE ECONOMY: THE CASE OF BIOREFINING IN AUSTRALIA. ECOLOGICAL ECONOMICS 107:84-93.

We investigate the economic and employment consequences of introducing a new sugarcane-based biofuel industry into Australia. We model the new biofuel industry on the production recipe of the existing large-scale gasoalcohol and alcohol sectors in the Brazilian economy. To this end we utilise a hybrid IO-LCA (input–output life cycle assessment) approach, which involves inserting data on new processes and/or sectors into an existing IO table. In particular, we develop and test an analytical and a numerical approach for re-balancing an IO table augmented with rows and columns representing large new biofuel industries. We quantify changes in economic output and employment in the Australian economy. We conclude that a future biofuel industry will be employment-positive for Australia.

KANEMOTO K., MORAN D., LENZEN M. and GESCHKE A. (2014) INTERNATIONAL TRADE UNDERMINES NATIONAL EMISSION REDUCTION TARGETS - NEW EVIDENCE FROM AIR POLLUTION, GLOBAL ENVIRONMENTAL CHANGE 24:52-59

Many developed countries in Annex B of the Kyoto Protocol have been able to report decreasing emissions, and some have officially fulfilled their CO_2 reduction commitments. This is in part because current reporting and regulatory regimes allow these countries to displace emissions intensive production offshore. Using a new highly detailed account of emissions embodied in international trade we investigate this phenomenon of emissions leakage. We independently confirm previous findings that adjusting for trade, developed countries emissions have increased, not decreased. We find that the sectors successfully holding or lowering their domestic emissions are often the same as those increasing their imports of embodied CO_2. We also find that the fastest growing flow paths of embodied CO_2 largely

growing flow paths of embodied CO_2 largely originate outside the Kyoto Annex B signatory nations. Finally, we find that historically the same phenomenon of emissions displacement has already occurred for air pollution, with the result that despite aggressive legislation in major emitters total global air pollution emissions have increased. If regulatory policies do not account for embodied imports, global emissions are likely to rise even if developed countries emitters enforce strong national emissions targets.

LENZEN M., SCHAEFFER R., KARSTENSEN J. and PETERS G (2013) DRIVERS OF BRAZIL'S CO2 EMISSIONS, CLIMATIC CHANGE 121(4):815-824

Brazil's economic development has been underpinned by a diverse and – in a global comparison – unusual set of energy carriers, notably hydroelectricity and ethanol from sugar cane. Its energy mix makes Brazil one of the least energy-related carbon-intensive economies worldwide. Given that the country is fast becoming one of the world's economic powerhouses, decision-makers need to understand the drivers underlying past and current carbon dioxide emissions trends. We therefore investigate a) which key long-term drivers have led to Brazil's unique emissions profile, and b) the implications of these drivers for Brazil's national policies. We show that Brazil's emissions are growing mainly due to increasing individual standards of living, exports and population size, and that this growth is so far unchallenged by technological and structural improvements toward lower emissions intensities and more efficient production structures. As these trends are likely to continue amidst growing international pressure on key economies to reduce their carbon emissions, a decoupling of drivers from emissions is needed to simultaneously meet development and environmental goals.

MCBAIN D. and ALSAMAWI A. (2014) QUANTITATIVE ACCOUNTING FOR SOCIAL ECONOMIC INDICATORS. NATURAL RESOURCES FORUM, 38(3):193-202.

In this paper we consider the evolution of quantitative accounting of social indicators for measuring societal progress and sustainable development, with particular reference to economic analysis and social indicators. We examine the use of the System of National Accounts and introduce the concept of using input-output analysis for the development of social indicators. The use of satellite accounts for input-output analysis of environmental impacts and the development of environmental footprints has been well documented. The novelty of this paper is the use of a methodology frequently used to develop environmental indicators to quantify social impacts and to further the development of social footprints. We provide a case study of the use of social satellite accounts for labour, using multi-regional input-output analysis to develop a global inequality footprint for labour embodied in trade, and argue the case for the development of a system of social economic accounts, similar to the System of Environmental-Economic Accounts adopted by the United Nations Statistical Commission in 2012. This work contributes to the development of social valuation metrics as a means for measuring societal progress and developing sustainability indicators for use in management and decision-making.

MORAN D., MCBAIN D., KANEMOTO K., LENZEN M. and GESCHKE A. (2014) GLOBAL SUPPLY CHAINS OF COLTAN: A HYBRID LCA STUDY USING A SOCIAL INDICATOR. JOURNAL OF INDUSTRIAL ECOLOGY

The spot price for tantalum, a metal used in high-performance consumer electronics, spiked in 2000, triggering a boom in artisanal mining of surface deposits in the Democratic Republic of Congo (DRC). The profit from columbite-tantalite ore, or coltan, is alleged to have funded militants during that country's civil war. One warlord famously claimed that in 2000, coltan delivered a million dollars per month. While coltan mining was neither a necessary nor sufficient cause for the civil war, there is nevertheless a clear association between mining and conflict. In order to trace global flows of coltan out of the DRC, we used a high-resolution multiregion input-output (MRIO) table and a hybrid life cycle assessment (LCA) approach to trace exports through international supply chains in order to estimate a "coltan footprint" for various products. In this case study, our aim is to highlight the power and utility of hybrid LCA analysis using high-resolution global MRIO accounts. We estimate which supply chains, nations, and consumer goods carry the largest loads of embodied coltan. This hybrid LCA case study provides estimates on illicit flows of coltan, estimates a coltan footprint of consumption, and highlights the advantages

and challenges of using hybrid monetary-physical input-output/LCA approaches to study and quantify a negative social impact as an input to production. If successful, the hybrid LCA approach could be a useful and expedient measurement tool for understanding flows of conflict minerals embodied in supply chains.

SCHULTE in den BÄUMEN H., MORÁN D., LENZEN M., CAIRNS I. and STEENGE A. (2014) HOW SEVERE SPACE WEATHER CAN DISRUPT GLOBAL SUPPLY CHAINS, NAT. HAZARDS EARTH SYST. SCI. 14:2749-2759

Coronal mass ejections (CMEs) strong enough to create electromagnetic effects at latitudes below the auroral oval are frequent events that could soon have substantial impacts on electrical grids. Modern society's on these domestic and international networks increases our susceptibility to such a severe space-weather event. Using a new new high-resolution model of the global economy, we simulate the economic impact of strong CMEs for three different planetary orientations. We account for the economic impacts within the countries directly affected, as well as the post-disaster economic shock in partner economies linked by international trade. For a 1989 Quebec-like event, the global economic impacts would range from USD 2.4 to 3.4 trillion over a year. Of this total economic shock, about 50% would be felt in countries outside the zone of direct impact, leading to a loss in global GDP of 3.9 to 5.6%. The global economic damage is of the same order as wars, extreme financial crisis and estimated for future climate change.

LUDWIG U. and BRAUTZSCH H.U. (2014) THE SKILLS BALANCE IN GERMANY`S IMPORT INTENSITY OF EXPORTS: AN INPUT-OUTPUT ANALYSIS. IN: INTERECONOMICS. REVIEW OF EUROPEAN ECONOMIC POLICY 49(2):102 – 110.

In the decade prior to the economic and financial crisis, Germany's net exports increased in absolute terms as well as relative to the growing level of import intensity of domestically produced export goods and services. This article analyses the direct and indirect employment effects induced both by exports as well as by of the import intensity of the production process of export goods and services on the skills used. It shows that Germany's export surpluses led to positive net employment effects. Although the volume of imports of intermediate goods increased and was augmented by the rise in exports, it could not undermine the overall positive employment effect.

Highlights in Books

CRISIS AND EMBODIED INNOVATIONS: FLUCTUATING TREND VS FLUCTUATIONS AROUND TREND, THE REAL VS THE FINANCIAL, VARIETY VS AVERAGE. Ryaboshlyk V. V. Palgrave Macmillan. 2014

This book upgrades dynamic IO models with an ability to catch the dynamics of crises, too, along with subsequent recovery (including jobless recovery). This also affords to overcome an artificial separation of the short and long runs, so far considered as autonomous disciplines, and endogenously combine them together. The crucial point here is the way in which technical progress is reflected. Leontief himself handed over the tradition of measuring progress indirectly as a gradual improvement of average characteristics of industries from year to year. This misled Leontief to an over-optimistic conclusion that the economy is able to achieve a smooth transition from the old to new technologies, while this might be rewritten in a more sober way: sometimes the economy is unable to achieve a smooth transition. The problem is that even the recent improvements based on the concept of Total Factor Productivity, TFP, still reflect the progress indirectly. At the same time, the passage to direct and explicit reflection of old and new technologies and of interplay between them opens the door for further insights. It has turned out that there are non-financial roots of the "financial" crisis; and that clear from crises future is a utopia, but crises are quite predictable and their depth is manageable. Due to this, the forecasting and early warning teams now can deal with turning points in the economy rather than with mere extrapolations and trends. This book proves that more than ever,

the input–output method, if modified, is a competitive tool to meet the challenges that a modern economy faces.

THE GLOBAL RESOURCE FOOTPRINT OF NATIONS: CARBON, WATER, LAND AND MATERIALS EMBODIED IN TRADE AND FINAL CONSUMPTION. Tukker A., Bulavskaya T., Giljum S., de Koning A., Lutter S., Simas M.S., Stadler K. and Wood R. 2014. ISBN: 978-3-200-03637-6.

Total global environmental footprint – encompassing the carbon, water, land and material consumption footprint of various countries – was compiled using one detailed, consistent and comprehensive global economic-environmental database. Using version 2.1 of EXIOBASE, this booklet endeavours to provide an insight into the environmental footprint of final consumption in the countries covered. It presents 43 country factsheets encapsulating the carbon, water, land and material footprint of final consumption in the countries covered by EXIOBASE. In this, it was decided to use simple indicators. The carbon footprint adds up greenhouse gases like CO2, CH4and N2O as CO2-equivalents. Land use cover change is not included in the carbon footprint indicator used here. For materials, the volume extracted has been counted; for water, the volume consumed (withdrawal minus return of flows); and for land, the surface used. The booklet further showcases a number of comparative analyses, such as how environmental pressures correlate to GDP, Human Development Index (HDI), and

population of a country. It illustrates the extent to which many developed countries rely on the carbon, water, land and material footprint from abroad.
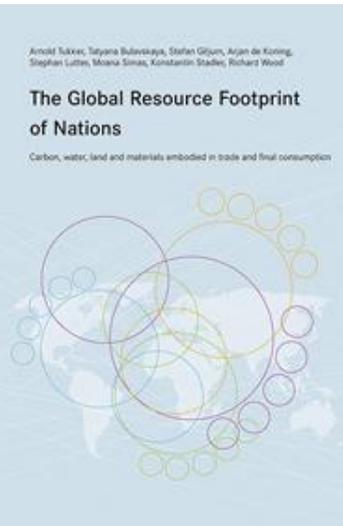
Fellows corner

Faye Duchin

1. How was it that you started working on I-O? Are there people or events that have been influential in your career?

My friend and colleague Dietrich Fischer introduced me to Wassily Leontief in 1977, and I joined Professor Leontief at New York University shortly thereafter as a research scientist at his newly created Institute for Economic Analysis. At my interview we discussed a variety of societal challenges like huge military budgets, unemployment, and the income gap between poor

and rich countries. Input - output economics was new to me, but I could sense its potential for better understanding these kinds of dilemmas, and the excitement of working with its creator was evident. I accepted his job offer on the spot.

2. You have impeccable credentials but having degrees doesn't automatically prepare one to do great research work like you have done. How did you pick up your reasoning skills? What sets you apart from other researchers? What's your secret?

I am interested in addressing real-world problems and also enjoy the intellectual challenges associated with more abstract theorizing and with mathematical modeling. For me the genius of input-output economics resides in the combination of the empirical content of its systematically organized databases, transparent mathematical formulations for manipulating them, and the ability to address important, complex questions. Professor Leontief was a pioneer in all three areas, and his accomplishments serve as the starting points for increasingly deeper inquiries. Today's input-output databases are of unprecedented empirical
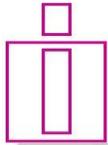
scope and detail, we have models of far broader theoretical reach than the iconic pair of $(I − A) x = y$ and $(I − A') p = v$, and the resulting frameworks make it possible to analyze truly strategic scenarios. My colleagues and I start an empirical investigation by formulating our questions, proceed to extend our models as needed, and then compile the data from many sources as best we can, using rough estimates when necessary. The greatest satisfactions come from the durable conceptual extensions we are sometimes able to make to the models and, especially, on those occasions when the empirical analyses provide us with revealing new insights.

3. What place would input-output analysis occupy in the History of Economic Thought? How would you relate input-output to different (and sometimes competing) schools of thought (Classical-Keynesian/Neoclassical)?

Input-output economics has experienced a renaissance over the past decade or so because of its unique ability to address socioeconomic challenges surrounding globalization, population growth, resource scarcities, and environmental degradation. This ability is due to a representation for technologies that is detailed enough to distinguish one ensemble of production processes from another, the interaction between physical relations and the dual cost and price relationships, and the fundamental openness and modularity underlying the input-output style of thinking that facilitates making theoretical extensions to existing models. Many input-output economists are relatively free

from a preoccupation with economic growth and a fixation on incremental changes, and we are committed to requiring physical feasibility in the representation of technologies and of factor endowments. These attributes make us unusually flexible partners in interdisciplinary collaborations where the concerns and mindsets of several scientific domains need to be incorporated into a common conceptual and analytic framework.

4. Could you mention some scholars of the past centuries that you would directly (or indirectly) connect to input-output in terms of their relevance for current analysis (e.g. Cantillion, Quesnay, Ricardo, Walras, Marx, Leontief, Sraffa)? Which aspect(s) of their line of thought would you deem most important?

For my work on sustainable development, broadly defined, the relationships that most interest me are mediated by technological options and technology transfer, physical constraints and monetary fees imposed by governments, and cultural shifts in citizens' attitudes about lifestyles and consumption, with their joint implications for changing comparative advantages, scarcity rents, development prospects, income distribution, resource use, and the state of the environment. The celebrated exchanges between Malthus and Ricardo three centuries ago were about many of these issues, and in the 20th century Boserup contributed complementary ideas about these relationships based on in-depth studies of communities in diverse historical and cultural settings. Also in the 20th century, Keynes established the legitimacy of a critical role for government policy in market economies, was a key architect of the

intergovernmental institutions that have shaped the global economy for the past half a century, and anticipated a future world increasingly free of economic necessity and guided by post-materialist values. Today we are in addition faced with prospects of resource shortages and the need to mitigate massive changes to earth systems, challenges that did not figure into the debates among earlier generations of economists. Identifying the strategic challenges, and articulating possible means for addressing them, together provide the raw material for formulating scenarios about the future. Professor Leontief provided a conceptual framework, both data structure and model, suited for analyzing such scenarios. He also carried out the pioneering empirical studies that could be considered early proofs of concept.

5. What are from your point of view the hot topics that IOA could address and has not done yet (or too slightly)? What other disciplines could enhance IOA the most?

One challenge for researchers today is to conceptualize ways to deal with serious and irreversible disturbances to the natural systems on which all life on earth depends and how to overcome the polarization of extreme poverty and material excess separating the billions of human inhabitants of the planet. Engineers are knowledgeable about the provision of necessities like water and energy and technological alternatives for these and other sectors, social scientists about how people form and change their attitudes and lifestyles, and many types of natural scientists about the climate system,

earth systems, and ecosystems. Economists can contribute a systems approach integrating consumption, production, and exchange activities and situating them in the context of the natural world. All these talents are needed to come up with solution concepts and to extend our analytic frameworks for evaluating them. For these collaborations to be fruitful, partners need to challenge each other's research questions and methods. Otherwise the process is a cut-and-paste operation that can establish links but probably not produce new insights.

6. What do you think the most important recent developments in the field have been? What do you think will be the most exciting and productive areas of research in I-O during the next few years?

My own research program has benefited from the striking progress in compiling and making available environmentally extended, multiregional input-output databases of the world economy. These databases are used extensively to quantify and monitor the various resources (and associated payments) embodied in both consumption and production activities, often summarized in the form of "footprints," in different parts of the world economy.

My colleagues and I use these data for other purposes as well, supplementing them by information from other kinds of sources to analyze scenarios about prospects for the future. I recently completed two papers with Steve Levine and Anders Strømman making the case for the benefit to our intellectual community of

integrating these two lines of input-output research. The resulting world modeling agenda would include tracking the global supply networks and payment networks associated with intermediate and end products, an area of growing concern where input-output economists have already begun to make distinctive conceptual and practical contributions.

7. How do you conceive the interaction between prices and quantities in an input-output system?

It is obvious that we need to capture in our analyses the interactions between quantities and prices, as they are fundamental to the workings of any market-based economic system. Fortunately, the basic, iconic input-output model is easily extended to reflect these interdependencies. The models my colleagues and I use are optimization models where the primal model minimizes factor costs subject to physical constraints, while the dual determines scarcity rents of factors and prices of goods that maximize the value of a given vector of final deliveries (measured in mixed units). We use this representation of price and quantity interdependencies both to analyze a single economy and in our models of the global economy. The basic connection that the models implement is this: When demand rises, prices rise for factors that become scarce and the goods in which they are embodied; when relative prices change, technology choices (and comparative advantages) shift.

8. How do you conceive the relationship between static and dynamic input-output modeling?

Shortly after I joined Professor Leontief at NYU he

asked me to develop a dynamic input-output model since, he said, his dynamic model was not useful for empirical analysis. With Daniel Szyld, then a graduate research assistant, I developed a new dynamic model (that we soon used to study the likely future impacts of automation on employment in the US). A dynamic economic model carries a lot of overhead in terms of data requirements and computational demands, and my approach has been to use comparative statics whenever that simpler framework can provide adequate answers. However, I am glad you ask this question, because after several decades during which I have not used a truly dynamic formulation, I feel that now the time has come to incorporate economic dynamics within our models of the world economy. Moving toward sustainable development will require choices among alternative technologies for a great deal of infrastructure to deliver electric power and fresh water, and built capital to satisfy many other demands, including expanding or replacing capacities already in place. A dynamic analysis model takes time lags explicitly into account and assures that adequate funding is generated for investment purposes. Meeting these objectives poses both modeling and data challenges.

9. Positive and negative elements of I-O?

Input-output economics has two unique strengths. First, it is able to take advantage of a great deal of empirical content in the form of an input-output database rather than relying on highly stylized formal assumptions. Second, input-output models capture various forms of
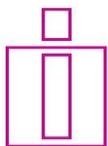
interdependence, starting from the distinctive ability of the iconic input-output model to quantify the indirect as well as the direct inputs to production. Other forms of interdependency have been successfully incorporated into more specialized input-output models and the data compiled to make them operational: the limitations of any given input-output model are more constructively viewed not as "negatives" but as challenges to our ingenuity to broaden further the conceptual scope of our models and extend our databases. Starting from the work of Anne Carter in the 1970s, the input-output linear programming framework has been used to capture the interdependence among technological choices in different sectors in a single economic region. Contemporary input-output linear programming models of the world economy extend this property to allow choice among technologies not only in individual economies but also across different economies, assuring consistency between sectoral production in one economy and deliveries of intermediate goods and consumer goods in the same or other economies, while also assuring that global money outlays for final goods do not exceed total factor earnings. I would say that we have made a lot of progress in recent decades in extending the conceptual scope of input-output models, but obviously this kind of work can never be considered completed.

10. What is your pet peeve with I-O-related published papers?

As a community we need to be bolder. In addition to compiling more data and formulating

better models, we also should return to the roots of our discipline in political economy and stimulate strategic debates about actions needed to meet contemporary social, economic, and environmental challenges. We should produce more papers about ideas, in particular ideas about scenarios for addressing the most important challenges, to supplement the already substantial quantity of important papers about data and equations.

11. Do you have other tips for doing great applied research work?

Pick problems you really care about. Find a few colleagues you enjoy working with. Together pursue an ambitious research program.

12. Your best work is...?

I am always enthusiastic about my most recent work, so this is hard to answer.

13. You obviously have a very successful research career. How do you feel now about the pressure to publish? Has your view changed over the years?

Thriving input-output research programs require a community of scholars who generate research questions, build new models, and compile timely data. It is necessary to get your work out in order to help build a productive, collegial research community and participate actively in it. All research positions come with performance expectations, and often a researcher's productivity is judged based on number of publications and journal rankings. But it is the quality of your contributions that ultimately determines how productive you have been, and the standard for quality should be one that motivates

you and advances your research program. An important attribute of a good research position is that its evaluation criteria should reinforce your objectives and standards, not undermine them. My views on this subject have not changed much over the years.

Calls for Papers

SPECIAL ISSUE

Journal Industrial Ecology special issue: Linking Local Consumption to Global Impacts. January 15, 2015

Globalization increases the interconnectedness of people and places around the world through markets, flows of capital, labor, services, information, and human migration. Goods and services consumed in one country are often produced in other countries and exchanged via international trade. As such, local consumption can have negative impacts on both the local and global environment, contributing to climate change, water scarcity, deforestation and other land conversions, all of which impact important
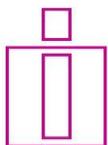
ecosystem services. The goal of this special issue is to bring together different approaches including global supply and value chain analysis, material flow analysis, life-cycle assessment, integrated impact assessment, and social network analysis to account for and analyze drivers of globalization and their global environmental impacts and global inequalities in wealth by explicitly linking the local to the global. Appropriate paper topics include:

• Theorizing, describing and analysing the local to global links between consumption and production within their biophysical, socio-economic and institutional contexts

• Assessing how consumption and production impact the environment and society at different spatial and temporal scales

• Calculating the main environmental indicators (e.g. carbon, water, land, air pollution) and socio-economic indicators (e.g. jobs, value added, wealth distribution) for different development scenarios and strategies

• Synthesizing current datasets and performing analyses on trade-offs and win-win strategies towards a more sustainable future.

• Theorizing, describing and analysing the local to global links between consumption and production within their biophysical, socio-economic and institutional contexts

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• Calculating the main environmental indicators (e.g. carbon, water, land, air pollution) and socio-economic indicators (e.g. jobs, value added, wealth distribution) for different development scenarios and strategies.

• Synthesizing current datasets and performing analyses on trade-offs and win-win strategies towards a more sustainable future.

Events

Course of Carbon footprint calculation ("Cálculo de la Huella de Carbono") November 18th-December 16th (Tuesdays and Thursdays), Madrid (SPAIN)

LCA, Carbon Footprint and Bookfeet Tool (taught in Spanish). More details: Sergio Álvarez

Equipo Huella de Carbono Montes-UPM

Southern Regional Science Association Annual Meeting. March 25th-26th, 2015, Mobile, AL (USA)

Individual papers and sessions are welcome. Proposals of sessions to: Santiago Pinto.
Deadline abstracts submission February 5th 2015.

IELab Conference June 11th-12th, 2015, Manly, Sydney, Australia

The first conference of the Industrial Ecology Virtual Laboratory project.

ECON CONFERENCES

iel

23rd International Input-Output Conference. June 22nd-26th 2015, Mexico City (Mexico)

Submission of abstracts:	**February 3, 2015**
Convened session proposals:	**March 13, 2015**
Registration opens:	**February 16, 2015**
Notification of acceptance:	**March 3, 2015**
Submission Leontief Mem. Prize:	**March 13, 2015**
Travel grants application:	**March 13, 2015**
Early registration ends:	**April 14, 2015**
Submission of full papers:	**May 5, 2015**
Registration:	**June 8, 2015**
International School of I-O Anal.:	**June 22, 2015**
Conference:	**June 23-26, 2015**

6th SHAIO Conference September 2015, Barcelona (Spain)

See updates at SHAIO.