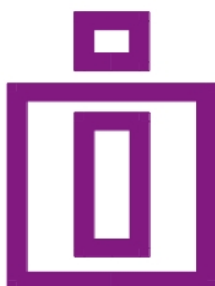# 27th International Input-Output Association Conference 2019
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BOOK OF ABSTRACTS
AND LIST OF AUTHORS

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Multi-level Comparisons of Input-Output Tables using Cross-Entropy Indicators

Topic: Classical IO applications: Trade, Tables and Tools
Author: Muhammad Daaniyall Abd Rahman
Co-Authors: Bart LOS, Anne OWEN, Manfred LENZEN

The availability of several alternative MRIO databases raises the issue of obvious variation in the analytical results that could cast doubt on their policy relevance. Upon this apprehension, comparative evaluations of different MRIO databases have been extensively discussed in the literature. Our study also contributes to this line of work, where we propose a novel method to comparing MRIO databases by introducing a cross entropy (CE) indicator. Specifically, we quantify the extent to which two input-output tables or two tables with results based on input-output analysis differ from each other. The CE indicator enables researchers to study differences between the inputs (the MRIO tables themselves) and outputs (the analytical results) of input-output studies at different levels of detail, in a single framework. More interestingly, the CE indicator can be decomposed, which allows for matrix comparisons at various levels within one coherent framework. To illustrate the power of this approach, we apply the technique to five multi-region input-output (MRIO) tables for 2011, derived from the Eora, EXIOBASE, GTAP, OECD and WIOD databases. We find that answers to questions relate to broader aggregates are generally quite similar, but that answers to questions at the level of single industries might be rather different.

Quantifying Skill and Ethnic Wage Inequality from Transpacific Partnership Agreement (TPPA): A Demand-side Analysis for Malaysia

Topic: DP2 Discussants: Peter McGregor, Jiemin Guo
Author: Muhammad Daaniyall Abd Rahman
Co-Authors: M. Yusof SAARI, Arunima MALIK, Manfred LENZEN

Trade liberalisation undoubtedly helps to enhance economic growth, increase efficiency and expose domestic markets to international competition. In fact, economic benefits from trade liberalisation are well documented in various international economic studies. While some empirical evidence to date has shown that trade liberalisation promotes economic growth, equally important is a growing body of research that addresses the effects of trade liberalisation on income inequality, especially for the case of developing countries. Focusing on the emergence of the international production fragmentation, our paper examines the wage inequality effects of trading with Transpacific Partnership Agreement (TPPA) countries on Malaysia. By combining national households micro-data and Eora database, it assesses the wage inequality effects of Malaysia's trade with BRICS and ASEAN countries, enabling us to make comparisons across a wide range of trade blocks. We consider a model where wage inequality can be assessed through demand from trade destinations and exporting industries, and where wages are differentiated by various skill categories and major ethnic groups. The results show that high wage inequality could have significantly occurred at different skill categories and across ethnic groups when trade with TPPA materialised. In particular, Chinese ethnics, who are commonly employed in high productive sectors, benefit the most compared with Malays and Indians. In contrast, exports to BRICS and ASEAN countries have minimal effects on wage inequality, suggesting that regional trade with comparable economic backgrounds could be more effective in reducing inequalities.

Measuring energy footprint in bottom-up energy transitions in the Basque Country

Topic: Thematic IO analysis: Energy and Environment
Author: Ortzi Akizu Gardoki
Co-Authors: Estitxu Villamor

Measuring energy footprint in bottom-up energy transitions in the Basque Country

O. Akizu-Gardoki*1, E. Villamor1, G. Bueno1, J. Heinonen2, J.M. Lopez-Guede1
1University of the Basque Country, Spain; 2University of Iceland, Iceland

Different sustainable intentional communities, rural villages and sustainable urban neighborhoods are trying to shift to the energy sovereignty, creating their own bottom-up energy transitions.

This research is an effort towards measuring the hidden energy flows of these communities, embodied in goods and services that are being consumed from both the national and international energy trade exchanges.

Currently, hidden energy flows between countries have been calculated and brought into discussion in the scientific community. Thus, when creating top-down national energy transition strategies, is nowadays easier to identify the embodied energy of whole countries. Nevertheless, in bottom-up initiatives, the dependencies with national welfare and productive systems are difficult to estimate, and have not been normally measured. This research provides the insights to start calculating the dependencies of local realities with national ones using Multiregional Input-Output methodology.

The analysis has been developed in three different bottom-up energy transition initiatives of the Basque Country, and compared with both the national and regional realities. The results could help these small initiatives to boost their energy sovereignty.

Modelling the distribution of Costs from Network/Infrastructural Upgrades for Electric Vehicles (EVs): who ultimately pays?

Topic: Thematic IO analysis: Life-styles, environment and economy
Author: Oluwafisayo Alabi
Co-Authors: Gioele Figus, Christian Francisco Calvillo, Antonios Katris

The UK and Scottish Governments have set ambitious targets for the roll out of electric vehicles (EVs). Both government and the car industry are predicting a rapid expansion in EV ownership over the next couple of decades. With that comes a shift in demand away from petrol and diesel fuels and towards electricity. The mass roll out of EVs will have a profound impact on the electricity system, and it is likely to require upgrades to the electricity network itself, which will carry significant costs. In this work, we address the crucial question of 'who ultimately pays' for the costs of upgrading the power network to facilitate the intended roll out of EVs. We adopt whole energy system and economy-wide models: TIMES and CGE to consider the knock-on effects across the economy of changes to the price of electricity faced by both residential and commercial users, and how this impacts spending power and demand from different final consumers, including different types of households. Our data include the UK Social Accounting

Matrix (SAM) produced by the Fraser of Allander Institute (FAI) and the underlining dataset of the UK-TIMES model. Our research gains novelty and significance, where existing studies have focussed mainly on the impacts of integrating EVs with the electricity system/network, grid control designs and the type of charging infrastructure and architecture to support uptake of EVs (see for example Dagsvik et al., 2002; Glerum et. al 2011; Link et al., 2012; Schmelzer and Miess, and Truong and Hesher, 2012). We believe that the type of information and insights emerging from this research will be of particular interest to policy makers, energy industry actors involved in the decision making on EV charging planning and decarbonisation of the transport sector.

Multisectoral analyses of industrial water use in Scotland: decomposition analyses, linkage measures and their policy relevance

Topic: Thematic IO analysis: Energy and Environment
Author: Grant Jordan Allan
Co-Authors: Scott J McGrane, Graeme Roy

There is an extensive literature on linkages between economic activity and water use, for instance in the production of water footprints, and virtual water. In some countries, a relatively water abundant climate offers the possibility to develop water-resources for economic development, an opportunity to which policymakers are alert, including through the objectives of the devolved Scottish Government's Hydro Nation Strategy. Such fundamental questions about the relationship between regional water use and economic activity have not previously been explored empirically through multisectoral analysis, partly due to a lack of data on water use at the sectoral level at a sub-national level level.

Our paper takes a novel dataset on Scottish premise-level industrial water consumption, connects these to publicly available Input-Output tables, and permits a unique perspective on direct and indirect industrial water use in a developed water-abundant region. Analysing this dataset through conventional (single-region) multisectoral modelling approaches – including Industrial Decomposition Analysis (IDA), Structural Decomposition Analysis (SDA), and linkage measures – we examine water use in the Scottish economy between 2012 and 2016.

In our results to date, we can identify the role played by improvements in sectoral water intensities in driving aggregate water consumption; the apparent complementarity between low carbon energy policy and water use through technology choices in the electricity sector; and changes in the spatial and sectoral pattern of industrial water consumption. Our findings have implications for a range of industry and policy actors in Scotland, including stakeholders in the water technology, policy and environmental areas.

Linking a multiregional input-output and a Hydro-Economic models to analyze the Ebro River basin

Topic: IO modeling: Conjoined Modeling Approaches
Author: Miguel Ángel Almazán-Gómez
Co-Authors: Rosa DUARTE, Raquel Langarita, Julio Sánchez Chóliz

In a previous work, we developed a multiregional input-output table for the Ebro river basin, with a high level of disaggregation in agriculture, which is really interesting when assessing the

socioeconomic and environmental impacts of several water scenarios. However, water is a flowing resource, so, its availability depends on time, space and upstream uses. For this reason, we have developed a hydro-economic model, which allows us to take those factors into account. One of the bases of hydro-economic models is the principles of the water mass balance and the continuity of the river flow, which, among other factors, determine the volume of water availability in the different river stretches. To maintain these principles, we mark nodes that account available water along the river and we formulate equations showing the link between the different nodes. That is, the hydrological component identifies the water available for use in each zone and also the destination of the water returns. The water extractions of each agent are associated with a specific node, so the water available for each agent is determined by the use of agents located upstream and by hydrology.

The other basis of hydro-economic models is the agent behaviour, characterized by some equations, which will be linked to the input-output table, where the productive structure appears and the intersectoral and interregional dependencies can be seen. To facilitate the integration of both methodologies, we have assumed a hydrological scheme in which we take into account the 5 regions composing our input-output table.

This combination of methodologies will allow us to simulate decreases in available water, in line with climate change, or increases in the environmental flows of the Ebro delta, and to evaluate the direct and indirect impacts in socioeconomic terms of those changes.

New method to build a PIOT without disposals to nature by merging data from a MIOT and from natural resource primary inputs: the brazilian copper PIOT case.

Topic: Thematic IO analysis: Industrial Ecology
Author: Aleix ALTIMIRAS-MARTIN

In 2012, the new UN national accounts handbook established the Physical Input-Output Table (PIOT) framework as the backbone for the new system of environmental and economic accounts. However, very few PIOTs have been built to date, mainly due to the heavy data requirements.

Therefore, any contribution, either to ease data requirements or provide simple but robust estimates, might help rekindling the interest on this framework.

The objective of this paper is to develop a new method to build a robust estimate of a PIOT with low data requirements.

The method uses the national monetary input-output table as a basis to calculate a unitless structure. Then, such structure is re-adjusted and turned into a physical structure by applying the natural resource primary inputs in quantity flows. The latter data can be gathered from the environmental accounts. This method differs from previous methods in that no specific data on yield ratios for any process are required (usually provided by expert estimates or LCA data). The advantage is the extremely low data requirements and the disadvantage is that the PIOT does not represent the wastes and emissions generated by the production process, since this information is not present in the original MIOT. A case study for the copper sector in Brazil will be developed.

The resulting IOT is a PIOT consistent with the national production structure but with a different structure than the original MIOT, i.e. with different technical and total requirements matrices. Thus, the new PIOT represents the production structure in physical units of the materials that are

embedded in final goods only, not of all materials consumed and partially disposed as wastes or emissions.

This PIOT, although incomplete, is a stepping stone towards developing quick estimates of the physical structure, which can be latter expanded to estimate wastes and emissions.

Keynesian multiplier and limits to the accumulation: an Input-Output analysis

Topic: Classical IO applications: Multiplier and Linkage Analysis
Author: Armando Andrés Álvarez
Co-Authors: Juan José López

This article deepens the Keynesian multiplier's effect on the income generated by final demand stimulus and the repercussion of the new value added on the final demand dynamization. Furthermore, the limits of the companies' accumulation generated for these dynamics and the possibility of inflation are analyzed. A new input output methodology is proposed. This methodology articulates Keynes' multiplier idea, the division of economic agents and their correspondent consumption's and saving's behavior proposed by Kalecki and Shaikh's classical economist's interpretation related to the limits to the accumulation. At first, the model is presented for a closed economy and without government, then is extended to a general model that incorporated the external and the public sector. The model is applied to El Salvador's economy using the 2014 Input-Output Table obtained through the transformation of the 2014 Supply and Use Table published by the Central Bank of El Salvador with the Eurostat's B model. The article's novelties are the possibility to calculate the sectorial Keynesian multipliers; the limits to the final demand stimulus; the model gives new approaches to understand in a better way the paradox of saving; the more general case of this model allows the analysis of fiscal policy and external sector effects.

Mind the gap! The challenge of using consumption surveys to feed macroeconomic models

Topic: Linking micro-data from consumption surveys and IO models: from theory to practice
Author: Antonio F. AMORES

Consumption micro-data are very useful for the analysis of the effects of policies across different types of households. However, feeding macroeconomic models with such kind of information is not a simple matter. Recent studies show that inaccurate procedures result in notably biased results. This paper describes the challenges, their sources and their impact if disregarded. It also explains how to tackle these using only open data and discusses the limitations. Finally, it presents some recommendations. This method estimates the net taxes and margins associated to specific consumer profiles. They are useful beyond impact analysis, i.e. to assess the fairness of the taxes related to consumption.

Trade-SCAN: an user-friendly Trade Supply Chain ANalysis tool

Topic: Classical IO applications: Trade, Tables and Tools
Author: Antonio F. AMORES
Co-Authors: Iñaki Arto, José M. RUEDA-CANTUCHE, Ignacio Cazcarro, Erik DIETZENBACHER, Miguel Perez, Maria Victoria ROMÁN

The European Commission is currently expanding its capacity to conduct studies in the domain of Input-Output analysis (data and modelling) in support of policies focusing on industrial competitiveness, growth and jobs, internal market, and trade and globalisation (e.g. global supply chains). Furthermore, Input-Output data enable more precise and comprehensive empirical applications on global supply chains, labour productivity and value added decomposition of gross exports by the use of additional socio- economic and environmental layers.
Within this research context, the European Commission's Joint Research Centre has developed with BC3 and the University of Groningen a new user-friendly computer tool called Trade-SCAN allowing for disentangling the domestic value added, foreign value added and double counted components of bilateral gross exports across all of the different countries included in the latest release (2016) of the WIOD database (www.wiod.org) and across various dimensions (time, country, industry...). The same applies for employment, skill levels, gender and age groups combining the WIOD database with the EUKLEMS database (www.euklems.net) release 2018.
This tool combines:
1) a module for ad-hoc calculations in real-time for specific queries. The definition of the sets and subsets of regions, countries, industries, factors and years are done in MS Excel spreadsheets that GAMS automatically reads in order to be flexible to changes of input data.
2) a dashboard of employment and GVC indicators such as the breakdown of gross exports; bilateral and total trade balance in gross and value added terms; employment and labour compensation embodied in EU exports to the world, etc.
3) pre-defined calculations and their associated databases in the form of pocketbooks.
The methodology to produce these results is crucial and the one implemented is largely based on the various existing contributions to the academic literature (Daudin et al, 2011; Johnson and Noguera, 2012; Wang, Wei and Zhu, 2013; Foster-McGregor and Stehrer, 2013; Koopmans, Wang and Wei, 2014; Nagengast and Stehrer, 2014; Arto et al, 2015 and Los, Timmer and de Vries, 2016, among others).

Regional and global patterns of insertion in value chains: evidence for Brazil

Topic: Classical IO applications: Trade and GVCs
Author: Inácio Fernandes de Araújo Jr
Co-Authors: Fernando Salgueiro Perobelli, Weslem Rodrigues Faria

This paper contributes to a better understanding of the different forms of insertion in global value chains.

The study performs a spatial decomposition of foreign value added inserted in global value chains. We introduce a measure of upstream integration in production chains based on the value added that each country provides in the initial stages for the global production of final goods. Thus, the regional and global insertion patterns are analyzed through the geographic extension of the production stages.

In this study, the focus of the analysis is the Brazilian economy, since its pattern of insertion in international trade is marked by distinct characteristics when considering its global or regional integration. For this purpose, the value added in Brazilian production is decomposed using an interregional input-output model for the period from 1990 to 2015.

The main results show that the insertion into the value chains occurs differently when considering their geographical scope and their upstream and downstream production stages. We also show that Brazil is relatively closed to international trade and little inserted in global production chains. The downstream and upstream insertion of Brazil in value chains is driven mainly by the global fragmentation of production. However, regional insertion has increased more than global insertion.

Degrees of separation and carbon embodied in China's supply chain networks in processing exports and normal production

Topic: Firm Heterogeneity and Input-Output Analysis
Author: Guadalupe Arce
Co-Authors: Luis A. LOPEZ, Xuemei Jiang

China's processing exports account for around half of its total exports and is concentrated on a few products, different from non-processing trade. At the same time, carbon embodied per unit processing exports in China is significantly lower than carbon embodied per unit non-processing exports, because they have less connection with domestic industries and lower domestic emission intensities (Dietzenbacher et al., 2012). In recent years, the share of processing exports in total exports of China keep decreasing, reflecting the structural change that is taking place in China that is increasingly adding value to imports rather than simply processing raw materials. In this context, we wonder about the consequences of these changes in terms of emissions embodied in trade and the differences in the emissions associated with both types of trade and how those differences are explained.

For it, in this paper we propose a Structural Path Analysis (SPA) to analyze China's processing exports and the related emissions and the differences with non-processing exports using the ICIO tables for 2011. SPA is used to identify the contribution each part of the value chain (Jing et al., 2015; Owen et al., 2018; Skelton et al., 2011; Zhang et al., 2017a), identifying key flows and industries, that drives the consumption-based accounting (CBA) emissions that are embodied in China's exports meeting the final demands of develop and developing countries, distinguishing the investment and consumptions demand. In a second step, we combine the embodied emissions flows resulting from applying the SPA with the complex network approach, using the community concept to identify the driving forces of virtual carbon in processing and non-processing trade and the main clusters of sectors and production phases. This joint analysis is appropriate for assessing the importance of layers or degrees of separation between companies from different sectors in the transmission of virtual carbon embodied in trade, which is an important novelty in the input-output literature.

Analysis of the distributional impacts of the Spanish climate and energy policy using a Dynamic-econometric IO model

Topic: Linking micro-data from consumption surveys and IO models: from theory to practice
Author: Iñaki Arto
Co-Authors: Kurt KRATENA, Xaquin Garcia-Muros, Ignacio Cazcarro

In order to meet the European Union's energy and climate targets for 2030, Member States are required to establish national energy and climate plans (NECP) for the period 2021-2030. These NCEPs integrate national the energy and climate objectives, targets, policies and measures. In the case of Spain, the NCEP establishes a reduction of 20% in greenhouse gas emissions by 2030 with respect 1990, and a contribution of renewable energies to the final energy consumption of 40% by 2030. The NCEP represents an important transformation of the Spanish energy system, with implications not only in the energy-environmental sphere but also in economic terms.

In this paper we analyze the economic impacts of Spanish NCEP using a new-Keynesian dynamic econometric model (DENIO: Dynamic Econometric Input-Output model). The model has been developed using data from different sources such as the Spanish National Statistical Institute (National Accounts, Supply-Use tables, micro-data of the Household Budget Surveys, micro-data of the Statistics on Income and Living Conditions, etc.), and Eurostat (Physical Energy Flow Accounts). DENIO is a detailed model with a breakdown of 74 industries, 88 products, 16 consumption categories and 22,000 types of households. The model allows analyzing the economic impacts of the NCEP, with special emphasis on the distributional effects across different household types.

The analysis shows a positive impacts in terms of increase in the expenditure of lowest income households. We also find that the increases in energy efficiency, and the associated reduction in the energy bill, have a positive impact in single people living alone, retired people living alone and single-parent families.

Household final energy use footprints in Zambia - lessons learned from quantitative studies

Topic: Construction and applications of the 2010 SAM for Zambia
Author: Marta Baltruszewicz

A recent study highlights the importance of using micro-data to better understand the relation between energy use and well-being (Brand-Correa & Steinberger, 2017). Using the average household as a unit of analysis gives a little insight towards the context of energy use. Employing micro-data in form of, for example, household surveys that contain information about individual households is therefore preferred for understanding the context of energy use depending on socio-economic characteristics and provisioning systems.

The objective of this study is to first identify what is the indirect and direct household energy use in case-study countries (Zambia and Vietnam), to then understand how do household energy profiles depend on characteristics of provisioning systems, such as urban form, dwelling type, access to facilities, ownership of appliances, as well as social contexts (e.g. unemployment, access to healthcare and education). The choice of case-study countries is one element of novelty as several studies pointed to a need for expanding research beyond developed countries (Donato, Lomas, and Carpintero 2015; Kok, Benders, and Moll 2006; Wiedenhofer et al. 2017).

The first step of the analysis focuses on household-level expenditure data from nationally representative consumer expenditure surveys (Living Standard Survey), which is mapped into Global Trade Analysis (GTAP) Multi-Regional Input-Output (MRIO) database. To quantify

households' indirect and direct energy use, a final energy extension using the International Energy Agency (IEA) database is created. This extension is integrated within MRIO model.

The second step of this analysis focuses on the understanding of contextual factors, such as geography, local infrastructure and surrounding amenities in influencing the links between level and types of energy use. These contextual factors fall under the umbrella of "provisioning systems" (see (O'Neill et al. 2018) supplementary material for a description). I will map the statistical links between household physical and social characteristics and categories of energy use (both direct and indirect) for both selected countries. I will then test diverse statistical methods to study the effects of provisioning system characteristics on the energy - socio-economic relationships, resulting in the quantification and empirical testing of the broad area of provisioning systems.

The preliminary results, presented here, from Zambian and Vietnamese case-studies showcase the value of this approach and introduce the method for the next step where resulting predictors of types and levels of energy use will be used to further establish relations between energy use and basic human needs.

Assessment of the sustainability of Mexico green investments in the road to Paris

Topic: Thematic IO analysis: Energy and Environment
Author: Santacruz Banacloche Sánchez
Co-Authors: Maria Angeles Cadarso, Yolanda LECHON, Fabio MONSALVE

Mexico is expected to rank among the top-ten largest economies in 2030 and to become the 6th in 2050 (PwC, 2015). According to EDGAR database, in 2012 it was the second largest polluting country in Latin America and the 10th in the world, regarding Greenhouse Gas (GHG) emissions. To meet the Paris Agreement, Mexico's INDC - "Intended National Determined Contributions"- is committed to reduce unconditionally 25% of its GHGs and Short Lived Climate Pollutants emissions (below BAU) for the year 2030. Since the strategy to achieve the mitigation goals needs an increase in renewable energy sources, Mexico's national climate change policy package has already been launched. A keystone of Mexico's green strategy is the increase in renewable energy sources throughout an ambitious program that imply the deployment of 20.3 GW of wind energy, 1 GW of biomass 11.8 GW of cogeneration and 2.2 GW of geothermal energy and 1.5 of solar energy.

In this context, this paper assesses the "green" energy investments required for the expected increasing capacity of renewable energy and their impact on production, value added, and employment by qualifications, materials, water and CO_2 emissions, by using the input-output analysis in a multiregional framework for estimating direct, indirect and induced effects of Mexican policies in the period 2012-2025. The green investments would imply an expected mitigation around 55 Mt CO_2 (SENER, 2015), once the new facilities are fully deployed. However, their construction phase as well as their operation and maintenance will increase emissions that should be accounted in order to achieve the planned emissions peak. In addition, the mitigation strategy should be seen as an opportunity to improve the development of the economy. This is the reason for the assessment of the planned investments looking for the three pillars of sustainability: economic, social and environmental.

TARIFFS, EXCHANGE RATE AND PRICE ELASTICITIES IN INTERNATIONAL TRADE

Topic: Issue in modelling international trade
Author: Rossella Bardazzi
Co-Authors: Leonardo Ghezzi

The issue of trade elasticities has been investigated by a recent stream of empirical research as protectionist policies have become popular in the agenda of policymakers. Many studies have estimated elasticities of trade to changes in costs, in exchange rates and in tariffs using different types of data and theoretical models. In general, there is no consensus on the value of these parameters and several international elasticity puzzles emerge. One is due to the difference in estimates depending on the type of data: trade elasticities are larger when based on microdata and smaller if estimated on aggregate data. Another puzzle derives from the assumption that, in most international trade models, the trade elasticities to costs, exchange rates and tariffs should be the same while empirical studies have shown that they differ (Benassy-Queré et al., 2018; Fontagné et al., 2018). Most empirical studies focus on either exchange rate or tariffs changes, and they use a reduced-form approach with single equation estimations. In this paper, we aim to contribute to the scarce literature that compares the effects on trade flows due to a change in costs, to a currency devaluation or to a protectionist policy with a structural multi-sectoral and multi-country model.

To explore this issue empirically, we use a Bilateral Trade Model (BTM) developed at INFORUM (Interindustry Forecasting at the University of Maryland) and a system of national models. As described in Bardazzi and Ghezzi (2018), the main features of the BTM are (i) a dataset of bilateral trade flows built using UN-Comtrade and Eurostat Comext data, (ii) a detailed disaggregation of commodity classifications, (iii) econometric estimation of import shares, and (iv) a linkage with national multi-sectoral models. A high level of disaggregation of trade flows is particularly useful to fully capture the complex interrelations between economies, to investigate issues of international competitiveness, and to simulate the detailed aspects of trade policies which are often tailored to specific commodity categories. Unlike other multi-country models where trade shares are exogenously assumed, in the BTM import shares are endogenous and estimated econometrically as a function of a set of explanatory variables at the commodity level. Finally, the BTM system linking national models enables understanding of the transmission channels of shocks via international trade to detailed industries at the national level. In this linking system, flows of commodities produced in country i and consumed in country j are affected by (i) changes in the import-to-domestic-purchase ratio in country j; (ii) changes in the share of country i in country j's imports; (iii) changes in the level of output of both countries. Therefore, the overall linking system of BTM and the national multisectoral models allows to estimate direct and indirect feedbacks between the economies included in the model through international trade flows. This modelling approach differs from traditional Multi-Regional Input-Output models (MRIO) built according the Chenery-Moses approach because it is truly dynamic: the amount of total foreign demand collected by a national model is not just the result of an exogenous shock on the total global trade but it's a combination of this effect and of the behaviour of the national economy in terms of investment and relative price/productivity.

All these features of the modelling approach represent the novelty of our research in estimating the trade elasticities.

We run the international system of models under different scenarios to calculate trade elasticities. We first run the BTM as a stand-alone model under the assumption of a change in

exchange rates between different countries and an increase of tariffs between the same countries. Results of these simulations produce the first direct effects of each policy on bilateral trade flows and the related trade elasticities. Then, the full linking system is run under the same policy scenarios, to take into account the effects of these changes in exports on national economies and include these feedbacks in the BTM. This second step produces another set of trade elasticities which reflect not only the direct but also the indirect effects for both policies.

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Population ageing, cohort effects and personal consumption expenditure

Topic: Demographic Shifts and Economic Modelling
Author: Rossella Bardazzi

Overview
Most developed economies are undergoing a deep transformation in their population structure with both an ageing process and a reduction of size. These changes influence, among others, the aggregate demand for goods and services, the amount of labour available for production and the circumstances under which that labour will be offered, and the public expenditures, raising the expenses for health care and pensions, while reducing the tax bases. This paper focuses on the impact of this demographic shift on personal consumption by expenditure categories using a demand system built in a multisectoral input-output model. The changing age structure is likely to affect both the level and the composition of personal consumption shifting consumer spending away from durable and non-durable goods to services. However, population aging does not imply that individuals at the same age but in different generations should behave similarly. There is a growing literature investigating how specific challenges and experiences people face in their daily lives can have a lasting influence on consumption behaviour. This experience-based learning give rise to heterogeneity in behaviour across generations because there are persistent effects through the lifetime of individuals (Malmendier and Shen, 2018). Therefore, it could be misleading to attribute the elderly current level of personal consumption to future generations: when the Millennial cohorts, which reached adulthood after 2000, will get 60 years old, their consumption choices will be determined by a set of experiences, norms and technologies largely different from their parents and grandparents. Moreover, growing inequalities in several dimensions – health, education, employment – interact and accumulate with age. The change in age structure combined with these trends results in ageing unequally (OECD, 2017).

Methods and data
Our modelling approach includes estimated age and cohort effects in a demand system of a long-term structural model. This demand system is based on the approach designed by Almon (1998) and uses both time-series and cross-section data (Bardazzi and Barnabani, 2001). In this paper, we estimate the pure age and cohort effects on sectoral consumption and include these effects in the demand system. This approach is novel because it encompasses not only the issue household disaggregation by age as in Kim, Kratena and Hewings (2015) but also the generational heterogeneity which persists across different ages. This source of heterogeneity

matters in long-term economic modelling.

The upgraded demand system is designed to be included in an INFORUM input-output econometric model of the Italian economy based on national accounts published by the Italian Statistical Office and microdata of the annual Household Budget Surveys for the period 1997-2017.

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Distributional Effects of Carbon Tax Policy in Iran, Input- Output Approach

Topic: Thematic IO analysis: Energy and Environment
Author: Fatemeh BAZZAZAN
Co-Authors: Aida Samavaty

Carbon tax as a form of carbon pricing, is a way of imposing tax on those who emit harmful carbon dioxide, or carbon dioxide equivalents, into the atmosphere. It is being touted as a way to reduce the world's fossil fuels consumption, will encourage the development of new clean and affordable energy resources, help to achieving the green economy, and the transition from existing ones. This policy tool has also more significant advantages that, if implemented corrective, can achieve environmental, economic and social goals in a coherent way, overcome market failures by pricing environmental costs, increasing efficiency and allocating resources optimally, making green products competitive, stimulating the development of new innovations, and overall enhancing social welfare. Moreover, governments also could return the money they get from the carbon tax to spend on public to reduce income and business taxes, payroll taxes or social security.

The overall effect of carbon tax may raise costs and slow economic growth. In general there are four possible spend of the government revenue: reducing the government budget deficit, reducing payroll taxes, reducing the corporate income tax, and providing per capita household grants. Economic models in this space are typically rare to design revenue positive scenarios. When revenue is spend to reduce the deficit, a carbon tax is moderately regressive—that is, it increases taxes by a larger percentage of income for lower-income households than for higher-income households. Using revenue to reduce the corporate income tax, would result in higher taxes for low-income families and disproportionate benefits for higher-income taxpayers. Using revenue to provide lump-sum rebates would more than offset the carbon tax burden for low- and middle-income taxpayers but leave high-income families with a net tax increase. Using carbon tax revenues to reduce employee payroll taxes would result in a net benefit for upper middle-income taxpayers, while increasing tax burdens modestly for low-income and the highest-income households. Generally, the equity of a carbon tax depends on how the revenue is spent on one hand and in the other hand how price increment due to carbon tax bring inequality.

This paper investigates the latter. Iran is among the top ten co2 emitting countries for decades. According to the official data of the Ministry of Energy, GDP and energy consumption have grown in three periods: 1993-1993, 1994-2004, and 2005-2015. In three periods, GDP growth rate was (2.1%, 3.6%, and 2.6%), while energy consumption growth rate was (6.5%, 4.9%, and 4.18%). Iran has submitted Intended Nationally Determined Contributions (INDCs) to the UNFCCC committing to cut the greenhouse gas emissions by 4% percent in 2030. Under the Paris Agreement, Iran must determine its policy and reports its contribution regularly. The implementation of this agreement can be realized with different policies. One of the short-term greenhouse gas emission reduction policies is carbon tax. In this direction, the main aim of this paper is to study distribution effects of carbon tax in Iran regardless on how the revenue spend.

For this purpose, at the first step, an extended environmental input-output table is prepared. For extension, one row is added to the input-output table and show co2 emission of each activity. At the second step a tax per metric ton of co2 emissions is considered as a shock price to the input-output price model. At the third step, suits index is employed to estimate the distributional impact of carbon tax policy.

The main data bases are: a) national 2011 input - output table, which has been constructed by, Islamic Parliament Research Center of The Islamic Republic of Iran. Input-output table is aggregated to 31 sectors due to insufficient data on sectoral energy consumption, b) households and sectoral energy consumption which have been provided by the Ministry of Energy (2011-energy balance sheet 2011), and the survey of mining and manufacturing from Statistical Centre of Iran. First results show that a tax on carbon dioxide puts more pressure on the rural household and suits index is progressive.

A global stocktake of energy use in food systems

Topic: IO modeling: Consumption-based accounting
Author: Paul Behrens
Co-Authors: Arkaitz Usubiaga

Food systems rely heavily on the exploitation of natural resources, ultimately resulting in a wide variety of environmental impacts. For instance, global food systems are responsible for between 15 and 20% of total energy use (1-2% is used in fertilizer alone). Different forms of energy are used through the life cycle stages of food. For instance, diesel serves as a fuel in agricultural machinery and transportation activities, natural gas is a key input in the production of fertilizers, electricity is critical in refrigeration etc. Likewise, energy consumption is connected to several impacts, notably climate change.

The food system is facing many deep and global pressures. At root much of this is driven by dietary transitions and growing populations/affluence. Increasing consumption volumes from population increases often requires either the development of new arable land (requiring further energy input) or increasing yields (also often resulting in increased fertilizers and energy inputs). Significant changes in dietary composition is driven by rising affluence, a process commonly termed the nutrition transition. The increased emphasis on animal products and proceed foods through this transition increases dependence on energy inputs as they are generally less efficient than plant-based alternatives. These trends have driven, and will continue to drive, large developments in food system energy use; both trends (increasing energy use through scale and composition effects) are predicted to increase for the foreseeable future.

Here we provide a global production and consumption-based stocktake of energy use in the global food system. Previous studies have focused on narrower set of products and activities,

often with greenhouse gases in mind rather than energy. We use the global MRIO EXIOBASE in combination with newly constructed energy extensions to investigate energy use in the food system. We place specific attention on fuels which are harder to decarbonise. For instance, we assume that anything that is already electrified will be easier to transition to low-carbon energy whereas diesel for heavy machinery and natural gas for fertilizer may be more challenging. I will describe how the energy extensions were constructed for EXIOBASE, how these were linked with EXIOBASE food sectors, and how we accounted for direct energy use for food preparation at home. I will present the preliminary results of our work and their implications from a production and consumption-based perspective.

Developing a consumer demand model with feedback mechanisms by combining input-output analysis and agent-based modeling to estimate future demand and environmental impacts

Topic: Classical IO applications: Industrial economics, Productivity and Efficiency
Author: Eivind Lekve Bjelle
Co-Authors: Kirsten S. WIEBE, Richard WOOD

Drawbacks of environmentally extended input-output analysis have been identified as its retrospective scope and lack of relevance to future environmental policy making. Furthermore, the lack of detail in the household consumption vector of MRIOs, along with the assumptions of representative, rational and non-interacting consumers in consumption modeling have been identified as limitations to modeling scenarios of future consumption using MRIO, but also for demand models in general. In this work, we seek to overcome these challenges by using an MRIO database comprising over 200 countries to develop country-specific demand models for a wide range of countries. The demand systems will use consumption data in a time-series from the MRIO to create models based on the Almost Ideal Demand System (AIDS) or the Perhaps Adequate Demand System (PADS). By using exogenous micro-economic data for several of these countries, we seek as an extension to the country-specific demand models to add elements of agent-based modeling (ABM) to the demand models. We do this by introducing a feedback mechanism of environmental information gained from the MRIO and supply this to the consumers of the ABM in every iteration of the model run, which in turn will influence consumer decisions and create scenarios of future consumption and environmental impacts. The goal here is to in a novel way combine ABM and MRIO to take advantage of the bottom-up perspective of ABM and the top-down perspective of MRIO. This can contribute to both overcome the limitations of MRIO in future demand modeling, and to increase the future environmental policy relevance of MRIO.

From Trade in Value Added to Trade in Income

Topic: Trade in Value Added and "servicification" of the Global Value Chains
Author: Timon I. BOHN
Co-Authors: Steven Brakman, Erik DIETZENBACHER

This paper investigates how much value-added created in a country translates into income gains for this country's residents as opposed to income gains for foreign suppliers of capital and labor. First, I deconstruct the GDP of 42 countries in the years 2013 and 2014 into bilateral exports of income by making novel use of the Balance of Payments, national accounts, and data on cross-border investment positions. The resulting redistribution matrix indicates what share of GDP is part of the same country's national income and what shares end up as part of the national

income of partner countries. The relation between GDP and GNI reveals that highly developed countries are the main beneficiaries of exports of income, largely at the expense of developing and emerging countries.

Next, I estimate the contribution of trade to GNI by applying the constructed matrix of bilateral trade in income. First I calculate the value-added generated in trade worldwide and then I redistribute all of this value-added into gains in income for each country. I find that in 2014 the contribution of trade to US GNI (the novel part based on the redistribution) was US$ 184 billion higher than the contribution of trade to US GDP (based on only US exports of value-added). Furthermore, I find that the US trade deficit decreased by more than 75% when trade balances are defined in terms of GNI instead of GDP. The results across all countries show that the discrepancy between GDP and GNI matters for who ultimately gains from trade. The national income implications of trade should thus be given greater attention by trade economists and policymakers.

Better all together? Exploring the effects of alternative scenarios for integration in the European Union

Topic: IO Data: Annual, Regional, and Multiregional Input-Output Accounts and Intra- and International Trade
Author: Lucía BOLEA
Co-Authors: Rosa DUARTE, Julio Sánchez Chóliz

The phenomenon of the emergence of groups of countries that share certain economic and political characteristics, has led to the generation of several economic areas in recent years that apparently seemed to work correctly, but that have finally had problems after the integration. This could be the case of the European Union, in which a group of countries decided to create an area in which they shared, not only certain political decisions, but economic ones. However, the arrival of the international financial crisis in 2007 caused imbalances in relations and collaborations between countries, both within the EU and worldwide. Several studies have focus on the analysis of the consequences of several recent economic phenomena some through econometric techniques, others with a multiregional perspective and others through building counterfactuals.
In this paper, the objective is to focus on the possibility of defining a type of synthetic indicators in an input-output framework, in a dynamic context, building "counterfactuals" and alternative scenarios to evaluate the impact of certain phenomenon in a European context, as well as in a global context. As a first example, and because of the problems that have arisen recently, the study of the "non-integration" of Eastern European countries could be an interesting scenario. We use the multisectoral and multiregional perspective provided by a MRIO model and the associated databases to study the evolution of EU countries in recent years, through the building of counterfactuals or parallel scenarios where the behavior of these countries is studied in the case that they had not participated in certain economic events.
More specifically, inspired by the synthetic indicators methodology and the hypothetical extraction methods we first study the trends in the intra-group, intra-EU and extra-EU trade relationships for these countries and in the technological and structural composition of the economies. Second, we design hypothetical scenarios on the trends in the evolution of these components based on the behavior observed in the pre-adhesion period and in different hypothesis of integration (this based on the trends observed in other world regional processes). These scenarios would help us to better analyze the contribution of the integration process on post-integration and current levels of economic growth and structural specialization of these

countries.

In this regards, this paper attempts to shed light on the discussion about the consequences of certain areas of economic integration, and the effects of these phenomenon on bilateral trade flows between countries within the EU and worldwide. To do this, the information provided by the World Input-Output database (WIOD), as well as the information provided by EORA database are used.

In our view, the results could contribute to calculate the structural effect of the most recent integration and disintegration processes within the European Union and worldwide, that currently set as a new challenge that must be faced by several groups of countries, which today present certain structural differences.

Revisiting the Natural Resource "Curse" in the context of trade in value added: Enclave or high-development backward linkages?

Topic: Classical IO applications: Trade and GVCs
Author: Filippo Bontadini
Co-Authors: Maria Savona

The paper puts forward and empirically tests the conjecture that specialisation in Natural Resource Industries (NRI) might not necessarily be a "curse" for (developing) countries, to the extent that it provides opportunities for export diversification in backward linked sectors à la Hirschman. We first revisit the evolution of the debate around the NRI "curse", including those views that are skeptical of diversification based on beneficiation from NRI. We then empirically test whether NRI might represent a sufficient "domestic representative demand" à la Linder for backward linked sectors such as Knowledge Intensive Business Services (KIBS) or high tech manufacturing that might provide new opportunities for export diversification based on virtuous pathways of domestic structural change. We find empirical support to this conjecture and discuss our results as a contribution to revisiting the NRI curse debate.

Absolute cost advantage and sectoral competitiveness: Empirical evidence from NAFTA and the European Union

Topic: Classical IO applications: Trade and GVCs
Author: Fahd Boundi

In this research we seek to answer the following question: What are the factors explaining the real terms of trade between the countries belonging to both the North American Free Trade Agreement (NAFTA) and the European Union (EU-28)?

More specifically, based on Anwar Shaikh´s theory of the absolute cost advantage, our aim is to verify the hypothesis that, during 2000-2014, the real exchange rates (REXR) of the German and the North American manufacturing sectors vis-à-vis their EU-28 and NAFTA partners, respectively, have been governed by the relative vertically integrated unit labor costs (RVIULC) and the intrasectoral gap of the rate of profit (R). Using panel cointegration techniques, we elaborated three econometric models. The first corresponds to the NAFTA countries, where the United States (US) is taken as the reference (national) country. The second corresponds to EU-28 with Germany as the national country. The third agglutinates NAFTA and EU-28, where we consider US as the national country.

We verify the existence of a unit root with Im, Pesaran and Shin (IPS), Maddala and Wu (MW), Choi, and Hadri tests. Secondly, we apply Pedroni, Kao and Fisher-Johansen tests to corroborate

that our series are cointegrated. Subsequently, we obtain cointegration vectors through Dynamic OLS (DOLS) and Fully Modified OLS (FMOLS) estimators. Finally, we employ an error correction model vector (VECM) to analyze short-run and long-run causal relationships.

The data used to calculate our variables were collected from the national input-output tables (NTIOs) and from the social accounting matrices (SAMs) of The World Input-Output Database Release 2016 (WIOD). The novelty of the research, representing the original contribution to the field, has to do with its being the first empirical test (using the WIOD database) of the theory of absolute cost advantage for the two main economic areas of the world economy.

Challenges of input-output modelling for statisticians – with a focus on environmental applications

Topic: SUT compilation issues relevant for users
Author: Maaike C. BOUWMEESTER

The mission of national statistical institutes is to provide high-quality statistics to inform decision-makers and the general public. Statistical institutes compile supply, use and input-output tables, as well as environmental accounts. However very few statistical institutes publish statistics estimated with input-output modelling, such as environmental footprints. The main challenge is how to produce high-quality environmental footprints with limited time-lag that can be regularly updated. Research groups have developed multiple multi-regional input-output databases. However, these are only updated if additional funds are obtained. The methods used are still experimental, usually not generally agreed and maintenance of the database is not guaranteed.

Currently, Eurostat and the Joint Research Centre are cooperating to develop an EU inter-country input-output (ICIO) dataset of high quality, with agreed methods, that will be regularly updated. This database should in the future be the standard reference for both statistical institutes and researchers. The first experimental table for the year 2010 was published last year. Eurostat also collects and publishes air emissions accounts, material flow accounts and energy flow accounts.

However, for using the EU ICIO table for applications, there are still challenges to overcome. First, the dataset only covers the EU. Integration with the ICIO of the OECD is foreseen, but may still be several years away. To estimate footprints, an interim solution to estimate the environmental flow or pressure embodied in imports is needed. A second challenge arises in the context of material footprints. The EU ICIO represents 64 economic activities, which is not enough detail to provide good quality material footprints. Introducing more detail is hampered by data availability and confidentiality. Hence, estimation methods are needed to introduce this detail. This paper discusses these challenges in more detail, presents ideas how to best handle them, and proposes a way forward.

Input-Output analysis and the richness of environmental applications: A researcher's perspective

Topic: IO's role in covering environmental policy needs
Author: Koen Breemersch
Co-Authors: Maarten Christis, Evelien Dils, An VERCALSTEREN

This paper analyzes the possible applications of IO analysis as an environmental policy support tool. We discuss several examples and their results to demonstrate how IO analysis can be applied to feed environmental policy decisions in the Belgian region of Flanders with quantified measurements and potential impact assessments of (hypothetical) policies. We argue that, despite the construction of interregional IO tables, the application of these IO models for environmental policy purposes can be hindered if environmental policy is set at a subnational rather than the national level, as is the case for Flanders. To this end, we integrated the regional Flemish IO model for the year 2010 constructed by the Belgian Federal Planning Bureau with the EXIOBASE interregional model and include the necessary environmental and economic extensions for the Flemish tables. We show that these tables can be used for the analysis of carbon and material footprints to highlight to policy makers the need to think of environmental policy in a trans-territorial way. Additionally, they can also be applied for monitoring how the environmental footprints evolve over time. Another route to support policy is through the analysis of (hypothetical) scenarios which are integrated within the IO tables through the alteration of existing industries, the addition of industries or the alteration of consumption patterns. We show several examples where such an approach was applied. The aim of this research is to gather examples on the possible application of IO, harvest the full potential of IO tables for environmental policy purposes and to ignite the debate on other interesting routes for the support of environmental policy.

The role of network linkages in the propagation of asymmetric shocks in the European Monetary Union

Topic: Classical IO applications: Multiplier and Linkage Analysis
Author: Koen Breemersch

This paper analyzes how asymmetric shocks propagate through the supply chain of the European Monetary Union (EMU). It is shown that the Chinese trade penetration shock is both sufficiently large in size and asymmetric in nature to make it a suitable shock to analyze the effects on European regional labor markets. Given the integrated nature of many of Europe's industries, our econometric model allows for the possibility that shocks propagate between domestic and foreign industries by relying on input output linkages. The WIOD database is used to construct these network shocks. The analysis provides several novel insights. 1.9 million jobs were lost as a result of the Chinese net import penetration shock in the EMU. The interaction of the industrial specialization and the network structure of its industries is important in driving this effect. Additionally, the network propagation of shocks causes considerable differences in the extent to which countries were affected by the Chinese trade penetration shock. The strong industrial ties of some of the small, open economies at the center of the EMU ensured that they gained from their supply of goods to that part of the German industry that benefitted from China's emergence at the world stage. Peripheral and larger countries only weakly imported shocks from abroad and had domestic industrial networks which exacerbated the negative effects of the Chinese trade penetration shock. One of the key findings of the paper is that the current industrial structure of the EMU exacerbates asymmetries rather than mitigates them. This would suggest that the

constrained set of tools that policy makers at the European level have at their disposal are insufficient to combat asymmetric shocks.

Recent Brazilian economic default were originated from real or financial issues?

Topic: Global Flow of Funds Data and its Applications
Author: Erika BURKOWSKI
Co-Authors: Jiyoung KIM

This paper aims to verify if the origins of recent Brazilian economic default (2009, 2015 and 2016) was related to real economy or pure financial transactions. The mehod used was the Flow-of-funds (FOF) originally proposed by Copeland (1942, 1952), complemented by Stone (1966) and Klein (1983), recently improved by Tsujimura & Mizoshita (2003), Tsujimura & Tsujimura (2018).
The FOF method was applied to Brazilian economy from the year 2004 to 2015 (restrict to availability of data). Data used are Balance sheet of Central Bank of Brazil (available in BCB web site), and National Financial Balance of Brazil (available from IBGE until 2009 and from and OECD from 2009 to 2015).
Results presents the evolution of discrepancy of dispersion index (DDI) with high values in precednt year of an economic default (2008 and 2014), however highest values in 2008. Structural path decomposition of change in DDI showed that financial transactions seems like a mirror of real transactions in almost of years, except in 2008, when financial transactions gave the higher contribution to the imbalance.
The total value of economic transaction of financial firms grew more than that of non financial firms in those precedent period of economic default (2008 and 2014) while the smooth growth of non financial transaction soften DDI in 2009 and 2015.
The evolution of power of dispersion indexes corroborated this observation pointing out that financial firms has improved its role in the economy , however, recently, government and non financial firms reduced their financial sharing while rest of world received Brazilian household´s savings.
The novelty of research is to go on flow of funds theoretical concepts which allow to measure and monitoring economic imbalances.

The future of energy intensive industries in Europe after the Paris agreement

Topic: Thematic IO analysis: Energy and Environment
Author: Mattia Cai
Co-Authors: Antonio F. AMORES, José M. RUEDA-CANTUCHE

Within the framework of the 2015 Paris climate agreement, the European Union (EU) has set itself ambitious greenhouse gas (GHG) emission reduction targets. Reaching those targets will require major changes in Europe's economic structure. This raises questions regarding the future of several energy-intensive activities, such as basic metal, glass, cement and chemical production. This study looks at how the position of those industries within the EU's production network might be affected over the next three decades by climate policies aiming to prevent a rise in global temperatures exceeding 2°C relative to preindustrial times.
We begin by constructing a set of forward-looking multi-regional input-output (MRIO) tables

reflecting hypothetical future states of the world under different climate policy scenarios. Specifically, two projected time series of global MRIOs are obtained, one for a business-as-usual expected development, and the other considering the technologies necessary to fulfil the 2-degree Paris agreement scenario. Both run until 2050 at five-year intervals with fine industry resolution. We use the resulting tables to analyze the centrality of energy-intensive industries in the European economy and how it would be affected under more stringent climate change policies. To this end, key sector analysis techniques are employed.

We combine two main sources of information: 1) a base-year statistical MRIO table that describes the global economy with a high degree of industry detail but can only be observed in the current time period, and; 2) a set of simulated country-level input-output (IO) tables obtained through a computable general equilibrium model (CGE), which provides a natural way of handling future counterfactual scenarios but cannot match the fine representation of international trade and productive activities of the statistical MRIO. To obtain the forward-looking MRIOs for our analysis, we calibrate the base-year table to meet the restrictions implicit in the relevant CGE-generated scenario-based IO tables. For this purpose, the KRAS algorithm of Lenzen et al. (2009) is used. The base-year MRIO table was retrieved from Exiobase (Stadler et al., 2018) and relates to 2011. The CGE model underlying our analysis is the General Equilibrium Model for Economy-Energy-Environment (GEM-E3) developed and maintained by the European Commission's Joint Research Centre (Capros et al. 2013). A complete description of the scenarios employed in this study can be found in Keramidas et al (2018).

Naturally, the 2015 Paris climate agreement has already received a great deal of attention from environmental economists. In particular, a number of studies have already appeared that take IO approaches – e.g., in a recent volume edited by Dejuán et al. (2018). With respect to this strand of literature, we believe that our research presents three elements of interest. First, in contrast to most existing contributions which focus on the power sector, our analysis is primarily concerned with energy-intensive manufacturing. Secondly, we seek to assess climate policy's impact on the structure of the economic system, rather than on employment or GHG emissions levels. Finally, the methodology that we propose for integrating dynamic economy-energy-environment models into the MRIO framework represents an alternative to other approaches documented in the literature, such as those of De Konig et al. (2016) and Wiebe (2016).

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Global Value Chains and Employment in the Mining Sector

Topic: Classical IO applications: Industrial economics, Productivity and Efficiency
Author: Beatriz Georgina Calzada Olvera

Much of the controversy surrounding the potential of the mining industry is its limited ability to generate employment. We follow the approach of Los et al. (2015) and Wang et al. (2017), to analyze how employment is generated in four middle-income countries and four high-income countries with relatively large mining sectors. We utilize the World Input Output Database (WIOD) and we cover a period from 2001 to 2014. Using decomposition methods, we distinguish the growth rate of employment due to final demand as an effect of a) changes in labor productivity b) changes in the ratio of value added to gross output (which may be the result of an upgrade within GVCs but it is also expected to be limited due to the unvarying nature of most mining commodities), c) changes in inter-industry structure or d) changes in final demand. The analysis thus provides an up-to-date examination of drivers of employment in the industry and whether the incorporation of mining activities into GVCs has a substantial impact on employment generation.

Reducing food waste throughout Europe: economic impact measurement using budget-constrained expenditure multipliers

Topic: Classical IO applications: Multiplier and Linkage Analysis
Author: Pilar CAMPOY-MUÑOZ
Co-Authors: Manuel A. CARDENETE, María C. Delgado, Ferran Sancho

About one-third of food produced for human consumption is lost or wasted, becoming a major global issue that threatens a sustainable food system and generates negative externalities in environmental terms. Avoiding this wastage has an economic impact on national economies, which has been traditionally assessed in terms of resource savings. The effect of such reduction has also been analyzed in terms of output and employment, using standard expenditure multipliers. This paper attempts to improve this latter approach by using budget-constrained expenditure multipliers, which allows us to consider the reallocation of expenditures due to the wastage avoided. To do this, we use Social Accounting Matrices for a sample of European countries with different economic structure.

On the estimation procedure of the new I-O UK regional model: SEIM-UK

Topic: Socio-economic impact modelling in the UK: Building a new model in uncertain times
Author: Andre Carrascal Incera
Co-Authors: Raquel ORTEGA ARGILES, Diana Gutierrez Posada, Geoffrey J.D. HEWINGS, Tasos Kitsos, Kurt KRATENA, Deniz Sevinc

The main objective of this paper is to present the different steps in the construction of a new

impact assessment model, based on a multi-regional input-output (IO) framework for the UK: the SEIM-UK. The multi-regional model will cover 37 regions (NUTS-2 classification) and it will include foreign trade flows with other countries, as well as different households' profiles by socio-economic characteristics (age, income, etc.). The main databases feeding the model are the Living Costs and Food Survey, the Annual Survey of Hours and Earnings, and the UK trade info from HMRC, as well as the recently developed EUREGIO tables. In this model, we offer a larger disaggregation in terms of regions, industries and commodities with respect to previous alternatives using a regionalization method that maintains the consistency with the national/non disaggregated values. After explaining how the model was built, we will show some of its potential applications. Specifically we will be focusing on: (i) globalisation (trade openness, outsourcing and migration), technological change, and structural change in the labour market; (ii) household heterogeneity and socio-demographic change; and (iii) change in trade patterns and value added chains (substitutions in trade between domestic and imported products, disruption of supply chains).

Regional price spillovers in the UK: The impact of an increase in import prices from the EU

Topic: Socio-economic impact modelling in the UK: Building a new model in uncertain times
Author: Andre Carrascal Incera
Co-Authors: Raquel ORTEGA ARGILES, Kurt KRATENA

The objective of this paper is to quantify regional price spillovers (implying changes in price competitiveness) across UK regions, stemming from an expected increase in the costs of imported products from the European Union as a result of Brexit. The price model of a multi-regional IO model of the UK (SEIM-UK) is applied for this purpose, which is a framework that has not received too much attention from the IO literature so far. The matrix of input coefficients derived from the use matrices is aggregated into K, L, M factors, and a nested structure of inputs is implemented. In the second nest, the factor M is split up among imported and domestic inputs. The change in (exogenous) import prices for commodities from the Rest of the World in each region is directly affected by the import price shock and indirectly via the loop of the price model. The indirect effect has an impact on output prices, via the impact on the price of M (intermediate inputs), as well as via the price of K (via the price of investment goods, linked to industries via an investment matrix). Price spillovers then work via the multi-regional trade structure in the model.

UK regional urbanization patterns and their economic consequences

Topic: Socio-economic impact modelling in the UK: Building a new model in uncertain times
Author: Andre Carrascal Incera
Co-Authors: Diana Gutierrez Posada, Stephan Weiler

UK is a country where more than 60% of the population live in regions with a density of 350 inhabitants per square kilometre or over. In the last 15 years (from 2001 to 2017) this urbanization process has continued, showing higher population growth rates for larger and denser agglomerations. Furthermore, in the last 5 years the speed of this process has increased considerably. In the period 2002-2012 the UK's urban population grew at an annual pace 1.32 times higher than the rural one, accelerating to a pace 2.20 times faster from 2012 through 2017.

There is a set of advantages for why people choose to move to larger cities already studied in the related literature such as higher expected wages, better searching and matching processes linked to a larger labour market, further access to amenities, among others. However, instead of evaluating the causes of urbanization, this paper assesses the main economic consequences of this demographic trend. In particular, we focus on the fact that urban and rural populations clearly differ in their lifestyles and, consequently, in their consumption patterns. According to the Living Costs and Food Survey data of 2017, while urban populations spend significantly more on Housing, Fuel and Power as well as in Clothing and Footwear; rural households spend more on Transport. At the same time, urban regions depend on the primary products and energy produced in rural areas, while cities are mainly specialized in the provision of services. We can further control for differences in levels and sources of income, given divergences in rural and urban regions in terms of wage/salary, and asset-based income flows.

As a first approximation to this issue, we extend the SEIM-UK multiregional model, including different types of households and workers in a Miyazawa fashion, to account for the main employment, output, and value-added effects that urbanization process has on the different 37 UK regional economies.

Assessing structural change in the Maltese economy via the application of hypothetical extraction analysis

Topic: Classical IO applications: Economic Structural Change and Dynamics
Author: Ian P. Cassar

This paper assesses the extent of change in the production structure of the Maltese Economy on the basis of three symmetric input-output tables, covering the time period from the year 2000 to 2010, via the application of hypothetical extraction analysis. Two methods were applied; the first method allowed for the estimation of the total effects resulting from a sector's hypothetical extraction in terms of the percentage loss in total gross value added, total labour income and total employment. The second hypothetical extraction method was applied to generate backward and forward linkage indicators that were subsequently utilized for the identification of the key sectors. The results obtained indicate that the production structure of the Maltese economy has passed through a number of important structural changes over this period. The manufacturing sector has experienced a decline in its overall relative importance, which is nonetheless still highly significant, whilst a number of service sectors such as the professional, scientific and technical activities and administrative and support service activities sectors as well as the arts, entertainment and recreation activities sector have on the other hand experienced a substantial increase in their overall relative importance. The results generated also illustrate the increased relevance of foreign nationals to the production activities of the Maltese economy. Another key finding of this paper pertains to an increase in the number of sectors which were classified as key sectors, over the specified time period, indicating a higher degree of sectoral interdependence implying greater sectoral diversification.

Mexican manufacturing and its integration into global value chains

Topic: DP5 Discussants: Satoshi Inomata, Fernando Perobelli
Author: Juan Carlos Castillo

This paper studies the value added contributions to final manufacturing output produced in Mexico. It distinguishes between contributions originating from foreign producers located in different major regions of the world economy and contributions made by domestic producers. The analysis is performed for the main two components of Mexican manufacturing: assembly plants producing for export markets (Maquiladora industry) and manufacturing firms mainly producing for the domestic market (Domestic Manufacturing). To this end, Mexico (Maquiladora) and Mexico (Domestic Manufacturing) are separately included into World Input-output Tables (WIOT) from 1998 to 2011. The empirical analysis shows that the structure of value added contributions with regard to the final output of the Mexican domestic sector has remained unaltered, while the structure of value added contributions to the final output of the Maquiladora sector has drastically changed over time.

For its own final output, Mexico (Domestic) has the largest share of value added contributions with some increase in the value added contributions of producers in foreign countries (notably, the USA). With regard to the final output of Mexico (Maquiladora) there was a shift from a dominance of US value added in all the manufacturing sectors (70% in 1998) to a much more diversified structure of value added contributions. By 2011, the East Asian share in value added was the largest in the Electrical and Optical equipment sector. Mexico (Domestic Manufacturing) and Mexico (Maquiladora) had the largest value added contributions in the Transport Equipment sector, while the US continued to account for the lion's share of value added in the textile industry.

In our view, those changes in the structure of value added contributions have to do with decisions by US firms to reallocate production to low-cost countries in Asia. They reflect changing patterns of the integration of Mexico in global value chains.

Unravelling drivers of global land use change

Topic: Thematic IO analysis: Industrial Ecology
Author: Ignacio Cazcarro
Co-Authors: Iñaki Arto, Eneko Garmendia, Itxaso Ruiz, Maria J. Sanz

It is well known that in the last decades the use of land worldwide has changed dramatically, and increasing concerns have been raised regarding forestland loss, degradation, and other forms of Land Use Changes (LUC). However, the factors driving these LUC are lesser known. This article aims to identify and quantify the main drivers of land use change for food purposes, bioenergy and forestry related purposes, at the global and country level from 1997 (after finding many challenges from then back to 1961, and agreeing on this year based on discussion with FAOSTAT experts) to 2013. Regarding the data and methods, making many statistics in physical units of the FAOSTAT database (production, trade balances, forestry statistics, and notably, the Supply and Utilization accounts which are the internal detailed data in FAO to construct the food balance sheets) as starting point, we firstly develop a consistent representation of this data in the form of a Multi-Regional Input-Output framework. Secondly, we develop a Structural Decomposition Analysis (SDA, see Dietzenbacher and Los (1997) Dietzenbacher and Los (1998), Su and Ang (2012) to quantify the contribution of each of a set of relevant factors to land use changes in the

different regions of the world. These factors include Yield, Affluence, Demand propensity, Demand structure, Trade structure, Input Structure and population. Previous works have analyzed the links between land use changed, diets and bioenergy (e.g. Alexander et al., 2015; Kastner et al., 2012). We extend this analysis with novelties by 1. updating the data series with latest available information; 2. including bilateral trade data in the analysis in order to estimate the share of land use change in one country due to imports from other countries and to analyze the impact of bilateral trade, 3. including land use changes related to forestry; 4. including affluence as an additional driver; 5. developing a statistical analysis to assess the correlation between different factors (e.g. affluence and land requirement, similar to Arto et al., 2016, for the case of energy and affluence). From the global assessment of forestland we can conclude that between 1997 and 2014, the harvested area has increased by 3.2 Mha (+18%), from 18.4 Mha to 21.6 Mha. The results show an increase in the forestland harvested that is embedded in trade (+33%). The global assessment of cropland reveals that between 1997 and 2013 harvested area has increased by 7% (+160 Mha), from 1,390 Mha in 1997 to 1,550 Mha in 2013. Similarly to what we find for forestland, the share of cropland harvested dedicated to satisfy the foreign demand for agricultural products increased from 19% in 1997 to 22% in 2013. Harvested cropland area increased in more than 10 Mha in four countries: Brazil, India, China and Indonesia; in Russia harvested area decreased in almost 30 Mha. The assessment of the drivers of LUC reveals that domestic changes contributed to increasing the harvested area in 35 Mha and foreign changes contributed to an increase of 125 Mha. The increase in affluence was the main driver for the expansion of harvested cropland followed by the expansion of population. Among those drivers that contributed to moderate the increase in cropland, we find the reduction due to the change in the propensity to demand agricultural products, and the change in the domestic trade and inputs structures.

Bridge matrices for feeding macroeconomic models with consumption survey profiles for the EU-28 countries

Topic: Linking micro-data from consumption surveys and IO models: from theory to practice
Author: Ignacio Cazcarro
Co-Authors: Antonio F. AMORES, Iñaki Arto, Kurt KRATENA

Macroeconomic models usually have a single representative household. However, more diversity of household types is needed to analyse the effects of multiple phenomena (i.e. ageing, gender inequality, distributional income impact, etc.). Household consumption surveys microdata is a rich data source for these types of analysis. However, feeding macroeconomic models with this type of information is not simple and recent studies show how even slightly inaccurate procedures might result in significantly biased results. This paper presents the full procedure on how to feed household consumption microdata into macroeconomic models and for the first time provides in a systematic way an estimation of the bridge matrices needed to link EU Household budget surveys microdata with the most popular multi-regional input-output frameworks (e.g. Eurostat, WIOD, EORA, OECD).

Reconfiguring RECONS Regional IO Models as Multi-Regional IO Models

Topic: IO Data: Annual, Regional, and Multiregional Input-Output Accounts and intra- and international Trade
Author: Wen-Huei CHANG
Co-Authors: Gregory Alward, Yue Cui

The US Army Corps of Engineers (USACE) is responsible for providing navigation, flood risk management, hydropower, water supply, recreation, and environment with an annual budget of $5 billion (US). To estimate total regional economic impacts of USACE's programs, a Regional Economic System (RECONS) was developed for both direct federal spending and related economic activities associated with USACE's infrastructure and programs. The RECONS database contains more than 1,500 regional input-output (IO) models of individual counties, multi-county areas, states, multi-state regions and the US. This collection of IO models includes geographic redundancies, as a state-wide model may implicitly include a county contained in another local area model. As a result, estimated impacts cannot be reliably aggregated over the geographic hierarchy of models as the lower geographical regions may not sum to the higher geographical regions. To overcome these shortcomings, RECONS I-O models are being re-estimated as multi-regional (MRIO) models. The first approximation solution is to re-estimate all regional models as 4-region MRIO models. For example, a single county IO model would be reconfigured as a MRIO model consisting of 4 regions: the county (Local), the rest-of-state (RoS), the rest-of-US (RoUS), and the rest-of-world (RoW). Each 4-region MRIO is internally consistent and additive across geographic scales, but not additive across different MRIO models. Our ultimate solution is to build a single MRIO model of the US economy with county-level spatial granularity. That is, the highest spatial resolution of the MRIO is an individual county and spatial groupings like multi-county regions and states are straightforward aggregations of county components. This paper will discuss the methods we have developed to spatially disaggregate the US IO model and produce MRIO models and how we have blended some IMPLAN data used to construct the original regional IO models with our own estimates of county-to-county commodity shipments.

Formerly Assembled, But Now Designed in China? Assessing the Domestic Value-Added of Activities in Gross Exports

Topic: China's (Inter)provincial Input- Output Tables: Applications and Advances
Author: Quanrun Chen
Co-Authors: Gaaitzen DE VRIES, Yuning Gao, Jiansuo Pei, Fei WANG

China has managed to increase the domestic value added content of its exports in recent years. But what is the nature of the global value chain activities that it performs? This paper measures the value added of China's activities embodied in its exports. We combine information on the activities of workers by industry and across China's 31 provinces from population censuses, with newly estimated inter-provincial input-output tables using value-added tax transactions data for 2002 and 2012. Our findings suggest the increase in China's domestic value-added in exports arises from an expansion of fabrication activities. This aggregate trend is driven by provinces like Guangdong, Jiangsu, and Zhejiang. Richer provinces such as Beijing, Tianjin, and Shanghai increasingly specialize in R&D and sales and marketing activities.

Trade benefit and interdependence in the APEC region: an application of the APEC TiVA database

Topic: Compiling and Applying the APEC TiVA Database
Author: Quanrun Chen
Co-Authors: Jiansuo Pei, Fei WANG, Zhi Wang, Kunfu ZHU

This study attempts to construct trade in value added (TiVA) indicators to measure the APEC TiVA under global value chains (GVCs). The TiVA indicators include bilateral trade in value added indicators, gross export decomposition based indicators, and global production indicators (such as the GVC income indicators). The indicators can be used to investigate the interdependence between APEC economies as well as the real benefit of the APEC economies gained from the interregional trade in the APEC region and from the trade outside the APEC region. To do this, the 2005 and 2012 APEC inter-country input-output tables are compiled based on the national supply and use tables as well as bilateral trade in goods and services data.

Global Fossil-fuel Subsidies and Emission Externalities: Inclusive Approaches to Welfare Assessment

Topic: Thematic IO analysis: Energy and Environment
Author: Maksym G. Chepeliev
Co-Authors: Dominique van der Mensbrugghe

For several decades energy subsidies remain on the top of international policy agenda, serving as one of the most debated and widely used policy tools. Several major international organizations have attempted to quantify global energy subsidies and provide assessment of their potential reform. This includes studies by Organization for Economic Co-operation and Development (OECD), International Energy Agency (IEA) and International Monetary Fund (IMF). While most of these contributions provide estimates of economy-wide effects, they lack consistent assessment of environmental co-benefits of subsidies elimination, which can have a significant influence on aggregate results and their regional distribution.

In this paper, we apply a multistep framework to analyze two global energy policy scenarios. First one includes elimination of pre-tax fossil-fuel consumption subsidies. Second scenario, in addition to the first one, includes imposition of the compensatory air pollution taxes, which correspond to the local air pollution externalities (post-tax subsidies). Dynamic computable general equilibrium ENVISAGE model is used to implement energy policies, quantify economic impacts, estimate energy use changes and emissions. Energy use changes are linked to emission of air pollutants and pollution-mortality impacts are estimated based on the population exposed by pollution and corresponding mortality risks. Finally, welfare benefits related to reduced mortality rates are assessed using country-adjusted willingness-to-pay measure from direct valuation studies. To account for the uncertainty associated with monetization of welfare co-benefits systematic sensitivity analysis approach is used to report the results.

Results show that inclusion of mortality and climate change related benefits has significant impact on net welfare estimates. According to our results, in case of pre-tax consumption energy subsidies elimination global (greenhouse gas) GHG emissions fall by 4.7-5.1% in 2050 and air pollutants emission reduction results in avoidance of 49-78 thousand deaths. Global monetary welfare co-benefits of such policy contribute to around $300-400 billion (international $2011) in 2050, turning some regions from net welfare losers to gainers. Most high-income countries experience insignificant pollution and mortality increase due to leakage effects.

Imposition of the compensatory air pollution taxes, in addition to pre-tax subsidies reform,

provides much more significant reduction in GHGs emissions and air pollutants emissions – by 22-31% and 17-39% respectively in 2050, depending on the baseline scenario. Associated premature deaths reduction are between 0.9 million and 1.7 million people in 2050. Introduction of air pollution-related mortality co-benefits to the conventional welfare estimates turns world welfare loss into gain under both baseline scenarios, with China turning from main loser to key gainer.

The Global Trade Analysis Project (GTAP) Data Base: Current Developments and Challenges

Topic: IO Data: Development of input-output data and their analysis
Author: Maksym G. Chepeliev
Co-Authors: Angel H. AGUIAR, Erwin L Corong, Robert Andrew McDougall, Dominique van der Mensbrugghe

This paper provides an overview of the Global Trade Analysis Project (GTAP) Data Base and its latest release, version 10. The GTAP Data Base has been used in thousands of economy-wide analyses over the past twenty-five years. While initially focused on supporting trade policy analysis, the addition of satellite accounts pertaining to greenhouse gas emissions, land use, water and air pollution has resulted in a surge of applications relating to climate change as well as other environmental issues. The Data Base comprises an exhaustive set of accounts measuring the value of annual flows of goods and services with regional and sectoral detail for the entire world economy. These flows include bilateral trade, transport, and protection matrices that link individual country/regional economic datasets. Version 10 disaggregates 141 regions, 65 sectors, 8 factors of production, for 4 base years (2004, 2007, 2011 and 2014). The 121 countries in the Data Base account for 98% of world GDP and 92% of world population.

Several satellite extensions complement the GTAP Data Base. There is an energy extension (GTAP-E) that tracks CO_2 emissions, the international migration and remittances data extension (G-Mig), the land use and cover extension (GTAP-AEZ), the foreign income payment and receipt data extension (GDYN), the disaggregation of the electricity sector (GTAP-POWER), the non-CO_2 emissions dataset, the GTAP air pollution database and the GTAP Data Base with incorporated fossil-fuel consumption subsidies. There is also ongoing work to release the GTAP Multi Region Input Output data (GTAP-MRIO), which allows for agent-level sourcing of imports by region of origin with differentiated preferences and tariffs.

Development of the core GTAP Data Base, as well as numerous satellite extensions poses challenges from both data and methodological perspectives. In this paper, we discuss our treatment of the selected data and methodological issues, as well as look into future challenges.

Introduction to the E3-India model

Topic: E3-India initiative- Regional solutions for economy and environment
Author: Unnada Chewpreecha
Co-Authors: Hector B. POLLITT

India's economy is rapidly evolving. Its strong economic and population growth are causing increased environmental pressures both domestically and at global level. The latest estimate suggests that India will need to quadruple its power generation capacity to meet demand in 2030.

At the same time, India is under pressure to mitigate climate change by controlling its emission growth. India's transition to a low-carbon economy requires a combination of ambitious policies. However, policy makers often do not have appropriate tools to help them understand policy impacts on economy, jobs and impacts among the states (where much policy is determined).

The E3-India model is an extended macro-econometric tool that captures not only economic and labour market interactions but also interactions between the economy, energy system and environment at state level. E3-India's structure is based on the System of National Accounts, with an input-output core that determines sectoral linkages in each state. Additionally, E3-India contains a bottom up technology module for power generation.

Agent behaviour is estimated from past historical data. As a result, E3-India is not bounded by the assumptions common to equilibrium models. Instead, the model is demand-driven and, under the right policy conditions, new policy can lead to increased economic prosperity and employment growth, drawing in excess productive capacity.

Together with local experts, we have constructed one of the most complete set of economic, energy, power sector, and emission time-series databases at state level. Our data start from 1993 and end in 2015.

E3-India is therefore a comprehensive tool for policy makers. Its wide range of policy inputs includes: carbon tax, energy tax, subsidy removal, tax reform, renewable promotions, energy efficiency, regulations and many more.

The Global Value Chains Analysis of Trade on Across-Strait: NRCA and Production Length

Topic: Classical IO applications: Trade, Outsourcing and GVCs
Author: LI-Chen Chou

The Global Value Chains (GVCs) is the character which comes from the basic consequent on economic globalization, and the value-added estimation under the concept of GVCs also brings attention highly. Traditional import and export statistics indicate there has a huge trade deficit between the countries with final goods export and the importing countries, but the added value inherent in domestic (Value-Added) part of the country's exports statistics are not as much in the countries with assembly behavior on final goods. In order to evaluate the GVCs between Taiwan and China in cross-strait trade, this study applies the methodology by Wang et al. (2013, 2014) and the World Input-Output Database (WIOD) which constructed by Timmer et al. (2012) and EU. Evaluates the real possession of production and Revealed Comparative Advantage indicator in cross-strait trade and exactly measure the industrial competition in the process of trade including production length, location and times.

EVALUATING THE VAW INDUCED MISALLOCATION IN THE MACROECONOMIC FRAMEWORK

Topic: Gender issues in IO models (II)
Author: Clio CIASCHINI
Co-Authors: Francesco Maria Chelli

The determination of the cost of violence against women and girls (VAWG) is an essential requisite to establish the border of the phenomenon and its impact on the economic and social system. However, nowadays it remains a disregarded topics, faced, occasionally, though heterogeneous and somehow defective methodologies. In recent times the most relevant and valuable efforts, are those based on the business approach, where attempts are made to define and evaluate the costs attributable to the specific cost centers according the institutions involved. Such microeconomic approach, however, confines the debate and fails to set the discussion at the broader level of the government policy testing a way of establishing the impact of VAWG on the levels of output realized and of incomes distributed by the entire economic system. In this paper an attempt is made to create a methodological connection for VAWG with the macroeconomic level through the multisectoral accounts and models. This is done under both the data organization and the policy model evaluations included the assessment of the distortions in the allocation of resources caused. The methodological attempt is developed along with an application on the Italian case. Microeconomic results of the only enquiry of the Italian case (Intervita) are linked to the latest Input Output table of ISTAT. As to data organization the extracosts of VAWG, pending on the Input Output sectors, such as public order, justice, healthcare, public administration, are attributed to a new fictitious sector, that we define as "Care and protection of the outcomes of VAWG" as joint productions. Under the profile of policy analysis, with reference to the Leontief method, we can evaluate the misallocation of public expenditure and the trade-offs for its alternative allocation in industries with higher productivity differentials.

Incorporating Natural Capital into A Computable General Equilibrium Model for Scotland

Topic: IO modeling: Computable General Equilibrium Modeling and Social Accounting Matrices
Author: Kevin Connolly
Co-Authors: Grant Jordan Allan, David Comerford, Peter McGregor

Research Question: Natural capital encompasses those assets which are provided by nature and which are valued by economic actors. As such, there is a clear analogy between natural and other assets, such as labour and capital, which are routinely included in models of national economies. However, the valuation of natural assets, to the extent that they are included in such models, is typically wrapped up in physical capital along with land values or not valued at all. This could be simply a measurement problem – natural capital might be difficult to appropriately disaggregate from other capital – or because they provide non-market goods which are not included within traditional measures of economic output. The purpose of this paper is to set out – both conceptually and practically – how natural capital can be added to a computable general equilibrium model. Method/Data: We focus on the conceptual differences that should reflect such an extension and we explore the empirical implementation of our approach through the addition of an agriculture biomass ecosystem services flow to a CGE model of the Scottish economy. This paper specifies the CGE model development as well as including some illustrative simulations. Novelty: The natural capital extended CGE model allows us to track the impact of disturbances,

including policy changes, on the economy and environment and therefore on sustainable development. In the longer term comprehensive coverage of natural capital stocks and ecosystem services will allow us to track the impact of disturbances, including policy interventions, on Green GDP and Genuine Savings, as well as on aggregate and sectoral economic activity.

Methodological considerations for estimating the total economic impacts of natural disasters for the agriculture industry

Topic: Thematic IO analysis: Disaster and Adaptation
Author: Christa Dean COURT

The agricultural sector frequently experiences substantial adverse impacts following natural disasters due to losses in crops, livestock, and animal products, as well as damage to buildings, equipment, fencing, irrigation systems, and perennial plantings. These losses and damages impact local businesses and worker communities that are economically dependent on agriculture. The manner in which data on agricultural losses and damages are currently collected, analyzed, and published in response to a disaster presents numerous challenges for stakeholders, including: 1) redundant and uncoordinated information collection efforts, 2) conflated reporting of losses (changes in economic flows) and damages (changes in economic stock), which should be reported and evaluated separately, and 3) prolonged temporal distribution of losses in agriculture as some occur immediately after an event while others might manifest over longer periods. Input-output models have a long history of use for disaster impact assessment. However, unique characteristics of the agriculture industry, namely the heavy reliance on operating loans and seasonal nature of expenditures for crop and livestock production in particular, make these and other methods that estimate total impacts based on backwardly-linked expenditures inappropriate for assessing the broader regional economic impacts of production losses. This manuscript focuses on conceptual and methodological considerations for producing unbiased, timely, and accurate estimates of direct economic losses to the agriculture system and associated total economic impacts to the region. An analysis of the total economic impacts of Hurricane Michael (2018) is presented as a case study of the novel methods proposed. Using geospatial data on cropland area and hurricane windswath along with survey data on direct losses for production agriculture and the agribusiness sector and input-output data for the State of Florida (2017) available from IMPLAN, the total economic impacts of agricultural losses associated with Hurricane Michael are estimated.

A comparison of Productivity Level among China, Japan, ROK and USA using international input-output tables

Topic: Classical IO applications: Industrial economics, Productivity and Efficiency
Author: Yanjuan DAI
Co-Authors: Hiroshi IZUMI, LI LIU

Abstract：The research questions of this paper are an improvement in method for international comparison of productivity level and showing the measured results concerning productivity level of China, Japan, ROK and USA.
Now many studies of productivity are done using of TFP (total factor productivity). We propose TLP (total labor productivity) as better indicator of productivity level. TLP is ratio of output to total labor (direct and indirect labor). Direct labor means labor used in the industry concerned. Indirect

labor means labor used for production of fixed capital, raw material, etc. Total labor quantity can be gotten by solving simultaneous linear equations using extended input coefficient matrix including not only ordinary intermediate input coefficient matrix but also fixed capital depreciation coefficient row and fixed capital formation coefficient column. Labor quantity inputted in imported fixed capital, imported raw material etc. can be calculated by using international input-output tables. We convert from calculated results in each country's price to results in common price using purchasing power parity.

We have used OECD World Input-Output Tables (WIOD) and Eora Multi-Region Input-Output Tables (MRIO) through internet. Also we have used ICP purchasing power parity (Basic Heading) gotten from World Bank. (Our deepest thanks to OECD, Eora and World Bank)

We measured TLP using national input-output tables for years. We wrote that TPL was better indicator of productivity than TFP in our several papers. In 2016 IIOA conference we presented a comparison of TLP growth among China, Japan, ROK and USA using international input-output tables. This time we will present a comparison of TLP level among them using international input-output tables and purchasing power parity. We will compare those with the results using national input-output tables. And we will make characteristics of TLP level comparison using international input-output tables clear.

FLAT TAX REFORM AND HOUSEHOLDS' DISPOSABLE INCOME IN ITALY: A DYNAMIC SAM-BASED CGE MODEL

Topic: IO modeling: Econometric, CGE and SAM modelling
Author: Silvia DAndrea
Co-Authors: Stefano Deriu, Rosita PRETAROLI, Francesca SEVERINI, Claudio SOCCI

The Italian Government is working over a fiscal policy reform to tackle the inequality and allow an increase in household disposable income to stimulate the level of final consumption and production. The reform proposed by the Italian Government concerns the replacement of the current progressive tax system with a flat one, introducing a flattened households' income tax based on two tax rates.

The analysis proposed, respond to the exigency of providing an ex-ante quantification of how such a policy affects the economic system both in aggregate and disaggregate terms. In particular, the study develops a dynamic Computable General Equilibrium model based on the Italian Social Accounting Matrix where the all the flows related to the Households are broken down by income deciles. The data from Households' income and wealth conducted by the Bank of Italy and Households' consumption made by the ISTAT are matched using the propensity score matching technique. However, to break down the flows related to primary and secondary income distribution according to income deciles, the SHIW is integrated with the taxes database of the Ministry of Economy and Finance. The dynamic CGE model is calibrated on the SAM and the policy scenarios are designed in order to simulate the change in the income tax rates to replicate the Italian Government fiscal policy proposal. The policy outcome might be twofold: on the one hand, after the implementation of the policy, the so-called "fiscal multipliers" could find greater application. In other words, through an increase in disposable income, there should be an increase in consumption and thus, an increase in overall income, triggering, over time, a process of increasing State budget. On the other hand, the new taxation system could reduce the tax burden especially for higher incomes, thus affecting inequality, unless the allowances system is modified accordingly.

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Relevance of exports for the economies of Mexico mesoregions.

Topic: IO modeling: Computable General Equilibrium Modeling and Social Accounting Matrices
Author: Alejandro DAVILA FLORES
Co-Authors: Miriam VALDES IBARRA

Over three decades (1985-2016), NAFTA (effective from January 1th, 1994 to date) allowed the accelerated expansion of the real value of Mexican exports (9% annually), increasing its participation in the GDP from 15.3 to 35.2%. In 2016, more than four fifths of the value exported

from Mexico (83.7%) is concentrated in US (80.9%) and Canada (2.8%).

In a rather rugged context, the new commercial agreement (renamed as USMCA by US government and T-MEC by the Mexican government) was renegotiated and signed (November 30th, 2018), pending ratification by the legislative bodies of the three countries.
In a previous work, based on the same methodology proposed below (Dávila and Valdés, 2018), quantified the total weight of exports in the main variables of the Mexican economy (43.7% of total gross production, 36.2 of employment, 32.9 of wages, 39.1 in indirect taxes on production, 43.6 in gross surplus, 40.5 of GDP and 39.7 of household income).

The main goal of this work is to determine the importance of exports for each one of seven economies of Mexico mesoregions. Those ones, cover the whole country. It is expected that the effects will be differentiated, depending basically on: their sectoral structure, the importance of exports in their final demand, as well as of the amount and composition of their intermediate consumption.

Specifically, over this paper we try to: 1. Quantify the importance of international sales for the main aggregates of those economies; 2. Subsequently, the multipliers are used as inputs for the computation of total elasticities for international exports. By doing so we can determine the sensitivity of main economic variables of the mesoregions to the unitary fluctuations in the value of exports. 3. Next, we apply the techniques of additive decomposition (Stone, 1985, cited in Miller and Blair, 2009) to determine the weight of different effects (initial, direct, indirect and induced), in the total export elasticities. 4. Finally, we measure the effects of the unit variations in exports of productive activities on the allocation of primary income and private consumption of households.

To do it, we build seven mesoregional expanded Leontief production models, based on the related Social Accounting Matrices (SAM's), with data of 2013 year. Each of one includes 32 productive activities and five institutional sectors (Enterprises, Government, Rest of the World, Rest of the country and Households, the last ones are disaggregated into ten groups according to income levels).

This is an applied research on the Mexican mesoregional economies, whose main interest lies in addressing a relevant issue of the current economic situation.

Key words: Regional linear general equilibrium models; Regional Leontief extended models; Regional social accounting matrices.

Decomposition analysis when there are common factorial effects: how to reduce its size?

Topic: Thematic IO analysis: Environment
Author: Paul de Boer

In many decompositions of an aggregate change in a variable into several factors there are one or more factors common to all research units (sectors, countries etc.) In our toy model, borrowed from Chung and Rhee (2001) (C&R), of the sectoral decomposition of carbon dioxide emissions the factor 'size of the economy', measured by GDP, is common to all sectors. It is straightforward to show that in the multiplicative four-factor decomposition GDP can be factorized out so that the decomposition is reduced to a three-factor one. In this paper we consider the additive

decomposition of the C&R model and - using a novel trick - answer the research question: 'Is it possible to reduce the additive four-factor decomposition to a three-factor one?' It is a multi-step procedure using at each step the Bennet decomposition which, by collecting duplicates, reduces the computation of the average of n! elementary decompositions to a weighted average of $2^{(n-1)}$ combinations. In the empirical part we apply it to the two datasets provided by C&R: (i) seven sectors in which changes-in-sign are present and (ii) four sectors without negatives.

This multi-step procedure allows for a considerable reduction in computational burden. As example we show that in the framework of the six- factor model with two common factorial effects used in Lan et al. (2016) an additive decomposition can be performed using the weighted average of $2^3 = 8$ combinations instead of computing the average of 6! = 720 elementary decompositions.

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Poverty and the functional distribution of income: in pursuit of strategies for inclusive growth

Topic: IO Data: IO and micro data
Author: Kenia B. DE SOUZA
Co-Authors: Tânia Moreira Alberti

The first Sustainable Development Goal is straightforward: "end poverty in all its forms everywhere". However, the means to active this goal are not simple. Between 2013 to 2014, poverty headcount ratio in Brazil reduced from 24.9 to 7.4% of total population, according to the World Bank (2018). After that, this trend shift, and the number of people living in extreme poverty has increased. These observations lead to the reflection that although the public policies developed so far have contributed greatly to poverty alleviation, they are not enough to keep the population out of the poverty trap. In this sense, the present work contributes to the discussion of inclusive growth policies, which allow work opportunities for the low-income population and self-sustaining elimination of poverty. To do so, we developed a microsimulation model integrated with input-output data for 2009 where consumption and income data from national surveys were merged, and sectorial information were analyzed in the light of Miyazawa (1976). Based on this detailed database it was possible to map, by sector and by household, the ways of transmitting economic growth through the labor market accessing not only the effects on poverty but also on income distribution. The results show how labor-intensive sectors are important to active the goal of ending poverty and how the income generated by those sectors can generate positive effects in the rest of the economy.

The previous year's prices supply and use tables: Estonian experience

Topic: Better to deflate SUTs but ... how to do it well?
Author: Iljen DEDEGKAJEVA

Organised session: Better to deflate SUTs but ... how to do it well?
Organizers: European Commission, Eurostat* and Joint research center**, Isabelle Rémond-Tiedrez* and José Manuel Rueda-Cantuche**

The previous year's prices supply and use tables: Estonian experience
by Iljen Dedegkajeva, Statistics Estonia

Abstract

This paper deals with the Estonian experience in the compilation of the supply and use tables at the prices of the previous year. Statistics Estonia published previous year's prices estimates produced within the detailed supply and use framework since 2010. The established system follows mostly the principles and standards for estimating annual national accounts aggregates in previous year's prices in the European Union. This paper gives an overview of the system (i.e. integration of current, and price and volume data, level of product detail and price information used for deflation, estimation procedures for the main national accounts variables, e.g. double deflation method, balancing). The paper discusses the key principles of the price and volume estimation such as consistency of valuation and consistency in deflation and provides examples of consistent deflation undertaken for domestic output and export sales within output, and for domestic and imported components of intermediate consumption and GFCF. Some further improvement of methods for price and volume estimates of service activities and implementation in practice is discussed.

Building a SAM for Zambia: from Green SUT to NAM and SAM

Topic: Construction and applications of the 2010 SAM for Zambia
Author: Iljen DEDEGKAJEVA
Co-Authors: Massimiliano LA MARCA

Organised session: Construction and applications of the 2010 SAM for Zambia

Building a SAM for Zambia: from Green SUT to NAM and SAM
by Iljen Dedegkajeva, Massimiliano La Marca

Abstract

The International Labour Organisation and the Central Statistical Office of Zambia jointly produced the first SAM based on SNA 2008 and the identification of selected "green industries" based on the System of Environmental-Economic Accounting (SEEA) and the Environmental Goods and Service Sector (EGSS) accounting systems. The outcome of the 3-year project is a SAM with 20 industries, a distinction between formal and informal activities, breakdown of compensations between occupations, status, and formal and informal employment. The SAM has

been produced by first generating a complete set of institutional accounts and a NAM (for financial, non-financial corporations, households, Government and NPISH). Labour force and living condition monitor surveys provided estimates on employment composition, income and consumption flows by household quintile.

The paper discusses the challenges and benefits of adopting statistical standards and guidelines such as SNA, SEEA and the newly published UN "Handbook on Supply Use and Input-Output Tables with Extensions and Applications" to generate comprehensive SAMs and show the policy relevance of their applications.

How are Supply, Use and Input-Output Tables, the basis of our analyses, compiled?

Topic: SUT compilation issues relevant for users
Author: Pille DEFENSE-PALOJARV

Users of supply, use and input-output tables (SUIOT) are always looking for most recent and detailed data to feed into their models and research, but often they have to face limitations in data. This paper aims to provide an insight how the SUIO tables are compiled in European countries and why the most detailed information is not always available.

The first part of the paper will focus on the wide range of data sources used by European Countries (e.g. surveys, administrative data etc.) feeding into tables. Part two will concentrate on the compilation process of different tables (e.g. frequency, timeliness, revisions etc.) and provide information about several compilation stages (working level, balancing, dissemination). Finally, dissemination of tables, indicators, multipliers, specific accounts etc. will be discussed. Results presented in this paper will be based on survey carried out by Eurostat, European Commission.

Impact on emissions, employment and the balance of trade of the decarbonization of the electricity production and transport in the EU. A MRIO multiplier-accelerator model.

Topic: Classical IO applications: Economic Structural Change and Dynamics
Author: Óscar Dejuán
Co-Authors: Mateo Ortiz, Ferran Portella-Carbo

The EU was the main supporter of the decarbonization proposed in the 2015 Paris Agreement for all the sectors and countries (UN, 2015). The "Energy Roadmap" approved by the European Commission few months later, committed EU countries to reduce GHG emissions by 40% in 2030 and by 80-95% in 2050 (EC, 2016). The European agenda has inspired our paper. More concretely, we aim at exploring the impact all over the world, of the European replacement of fossil-energy before 2050 in two energy intensive industries: electricity generation and transport.

The focus on the paper will be on impacts of decarbonization on emissions, employment and the balance of trade. The hypothesis is that, once fossil energies are replaced by renewable ones, the emissions will fall. Yet, in the meanwhile, a massive investment is needed in wind-farms, in the capital goods industry and in the production of car-batteries. This effort will be negative for emissions and positive for employment. The impact on the balance of trade will differ for each country.

For this purpose, we will apply a multiplier-accelerator model on a multiregional input-output table (MRIO). The paper introduces important novelties in the questions, the data and the methodology.

The main source of data are the MRIO tables provided by WIOD and EXIOBASE. The detailed analysis of the energy and transport relies on the data provided by EUROSTAT and the research institutions dependent on these industries. The main methodological contributions are the use of broad multipliers that capture both intermediate and final consumption and the accelerator of investment. Our model is dynamic in the sense that in the multiplicand we introduce the final demand of the economy that is expanding at a given rate and the investment necessary for the replacement of old capital goods and infrastructure

An IO-based methodology for calculating the impact of final demand changes by demanded products at purchasers' prices

Topic: Methodological aspects of input-output analysis
Author: Ana Maria Dias

Input-Output manuals normally present the calculation of output, primary inputs, employment and joint products (eg. pollution variables) multipliers using the so-called Leontief Inverse, pre-multiplied by the respective vector (or matrix) of coefficients (per unit of output). However, this method only estimates the impact of a unit change of final demand for each product if this demand is totally addressed to domestic output and expressed at basic prices, which is far from being realistic. In fact, the direct import content of final demand has been increasing over time and it is relatively high in small open economies. On the other hand, trade (and transport) margins and taxes on products also represent often an important (direct) share of the value of final demand. The methodology presented in this paper incorporates matrices for direct unit contents of imports, domestic output and taxes on products, as well as trade and transport margin rates in order to estimate the direct and indirect effect of a change in final demand for each product and demand category, at purchasers' prices and considering a direct import content. Its application requires the existence of a system of input-output matrices (for domestic output, imports, taxes, subsidies and trade and transport margins). This methodology was first developed and applied to the Portuguese economy by the author in 2010 and its first version was presented in a paper to the 19th IIOC (Alexandria, USA, 2011). This methodology started to be also implemented by the Portuguese Statistical Office in 2017 (to the input-output matrices for 2013 and, more recently, to 2015 matrices). This paper presents un updated and extended version of the methodology and an application to Portugal, comparing it with the traditional (abovementioned) methodology, showing its advantages for the impact evaluation of final demand when there is a change in its structure.

A shortcut to footprint calculations

Topic: IO modeling: Consumption-based accounting
Author: Erik DIETZENBACHER
Co-Authors: Hongxia ZHANG

It is well known how to calculate footprints and perform consumption-based emission accounting (CBEA). Yet several issues that hamper their acceptance in the debate on climate change are related to the underlying data. Footprints require global multiregional input-output (GMRIO) tables that are linked to emissions data. Questions that arise are: which GMRIO tables to use and does the industry classification do justice to the characteristics of a certain country? In this paper, we provide an alternative way to compute carbon footprints using national input-output tables (NIOTs). The idea is as follows. The footprints are obtained as the territorial emissions of a country minus the balance of trade in emissions. This balance is defined as the export of emissions minus the imports of emissions, both in a CBEA setting. Next, we use the fact that the balance of trade in emissions is equal to the balance of emissions in trade. The final step is to approximate the balance of emissions in trade from GMRIO tables with the emissions in the exports minus the emissions in the imports from NIOTs. In this way, each country (e.g. the US) can calculate the emissions in its own exports, using its NIOT. Another country such as Germany (using its NIOT) provides the emissions in the US imports from Germany. To test the possibility of calculating footprints from NIOTs (and testing the quality of the approximations) we compare the calculations with NIOTs from WIOD with the footprints from the GMRIO table.

Economic crisis and gender polarization in Europe? Insights from a MRIO

Topic: Gender issues in IO models (I)
Author: Rosa DUARTE
Co-Authors: Cristina Sarasa, Mònica SERRANO

Employment polarization has been one of the most relevant consequences of technological change in advanced economies late in the XX century. Economic literature has extensively documented the skill-biased technical change in advanced economies showing a "U" shape skill-labour demand distribution. The increase in the upper and bottom tails of the skill-labour demand distributions and the significant reduction in the medium skill categories of workers involved significant consequences on wages and income distribution.
However, the potential implications of this skill-labour distribution by gender remain largely unexplored in the literature. Moreover, recent studies in feminist economics highlight the relevance of sectoral feminization or horizontal segregation in the persistence of gender gaps. Both facts suggest a relationship between employment polarization and gender dimension, which is closely related with the sectoral composition of the economy, the specialization patterns and the drivers of growth.
In this paper, we explore the role of gender in job polarization and wage inequality for Europe from 2008 to nowadays. We provide evidence on the evolution of these indicators, as well as the structural, technological and specialization factors underlying. We particularly focus the analysis on the effect of the stylized facts found on the persistence of gender gaps and gender pay inequality.
Methodologically, we depart from a multisectoral and multiregional input-output (MRIO) model to develop several indexes accounting for employment polarization, gender dimensions, , gender pay gap and structural change in Europe. Decomposition of gender inequality is first explored on

the basis of these indexes. Then, we econometrically contrast the relevance of these factors to explain sectoral, country and regional gender differences in Europe.

Human Migration in a Globalized Economy: Groundwork for Analyzing Alternative Scenarios

Topic: Addressing Strategic Challenges of the 21st Century: Deepening the Collaboration between Input-Output Economists and Industrial Ecologists
Author: Faye Duchin

The major early waves of migration of homo sapiens out of Africa, between about 200,000 to 70,000 years ago, populated all the continents except Antarctica. Since then large-scale human dispersals have sought treasure and power, to escape violence or changes in climate, to satisfy curiosity or seek a better life or simply survive. Europe's Age of Discovery established colonies, transferred significant wealth back home, and for the first time directly linked the New World with the Old. In the mid 20th century World War II, a conflict unprecedented in its geographic extent, fatalities, and war crimes, displaced millions of survivors, many stateless. Today, the number of migrants has expanded to levels not seen since that time, both from one country to another and within the same country. Observers expect the current surge in migration to further intensify in response to changes in climate over the next several decades. This expansion will further exacerbate all the other causes of migration.

International trade in goods and services is a key feature of today's global economy, and these flows are explicitly represented in input-output databases and in input-output models, in particular models based on the theory of comparative advantage. The logic of comparative advantage has historically considered the factors of production to be immobile. Recent economic studies include different qualities of land and water, as well as individual fossil fuels, metals and other minerals, in addition to labor and capital as factors of production. While land and mineral deposits are effectively fixed in place, it is time to extend the logic of these models to explain international flows of factors of production starting in particular with workers and their households. That capability will enable examining alternative scenarios about future human migration.

This paper describes an input-output economic framework that limits its initial focus to exploring what might be entailed in effectively absorbing a historic level of climate refugees and other essentially involuntary migrants someplace on the planet by the mid 21st century. This focus requires explicit attention to demographics, in particular expansion or contraction of the population with associated impacts on the age distribution and the size of the labor force and the employment requirements. This paper serves as a scoping-out exercise with three initial aims. It describes several layers of logic for international matching of potential workers with jobs within an input-output modeling framework. It addresses changes in consumption patterns, material requirements for resettlement, and associated dependence on resources. Finally it identifies major categories of data and of assumptions about the future that
will be needed for an initial empirical analysis. Scenarios can explore the implications of region-specific policies on numbers and characteristics of migrants to be accepted or of international agreements.

Assessing the Impact of a Special Mining Tax over the Chilean Economy

Topic: Classical IO applications: Industrial economics, Productivity and Efficiency
Author: Juan Pedro EBERHARD
Co-Authors: Patricio AROCA, Loreto Bieritz, Nicolas GARRIDO, Anett GROSSMANN, Anke M. MOENNIG

The introduction of a special mining tax in Chile in 2006 allows us to study its impact. For the Chilean economy, the mining sector represents 50% of exports, thus any distortion caused by the tax may affect the entire economy. We use an estimated macroeconomic model to assess the impact of this new tax scheme. We construct a counterfactual standard tax regime to compare the evolution of the economy under both tax systems. We study both the impact at the aggregate level and by sector. We found heterogeneous effects at the sectorial level. Finally, we estimate the indirect effect associated with the differences in the government revenue´s dynamics.

Labor Movement forecast on the base of I-O approach

Topic: Demographic Shifts and Economic Modelling
Author: Ekaterina Aleksandrovna Edinak

The labor force movement is one of the economic growth factors associated both with the changing situation in the economy's sectors and in the regions. The use of an intersectoral approach is one of the ways to improve the reflection quality of this interrelation.
In a context of the general aging of the population, one of the Russia problems is the increase in regional inequality in population and labor force. The modern structure of Russia internal migration makes a significant contribution to the regional inequality growth. The country records a long-term population and labor force migration outflow from most of the northern and eastern regions of the country towards the western and southern regions. As a result, the population and labor force is concentrated in a small number of regions, primarily in megacities. These processes are a consequence of the spatial and sectoral structure of the Russian economy that has taken shape in the past two decades.
The Russia development is impossible without the gradual elimination of the most acute imbalances in the regions development. One of the conditions for regional balance is meeting the regions needs in the labor force corresponding to the sectoral needs of regional economies. Taking into account the demographic constraints, the main source of labor force growth in a region in the short and in the medium term is interregional migration.
Thus, on the one hand, migration is a consequence of socio-economic differences, including in the sectoral structure, the system of inter-sectoral relations between regions, and on the other, determines the potential for their economic growth.
In this regard, the study develops an approach to forecasting the labor migration structure to meet the regions needs and ensure their sustainable development.
The migration structure forecast is simultaneously built into several models. This makes it possible to link the macroeconomic forecast for the Russia development, which is being developed in the framework of the RIM and CONTO models, with the current opportunities and needs of regional labor markets, which are reflected in the regional labor resources balance. The result will be a multi-regional / sectoral distribution model of interregional labor migration. The main methods used in the process of building a model are balance method and correlation and regression methods. The lack of in-country migration models that would link macro forecasts at the level of economy's sectors on the one hand with regional development forecasts on the other

determines the novelty of the study.

Extraction-cum-substitution and the mapping of bilateral trade conflicts

Topic: Trade in Value Added and "servicification" of the Global Value Chains
Author: Hubert ESCAITH

IIOA-2019 submission: Extraction-cum-substitution and the mapping of bilateral trade conflicts
Hubert Escaith; January 2019
Key words: input-output analysis; international production network; trade analysis; extraction method; partial equilibrium

1. Objectives

A new production and trade business model arose in the late 1980's, based on the geographical fragmentation of complex production processes. In this process, trade in intermediate goods grew in importance, increasing economic interdependency within the World economy.

The purpose of this submission to the IIOA is to present a new approach that derives directly from traditional input-output analysis to derives plausible scenarios. The method remains exploratory in nature: it offers a series of "markers" corresponding to extreme or expected points that should help mapping what remain largely unchartered waters: the direct and indirect effects of bilateral trade conflicts on global production networks.

The paper counts with three parts, besides introduction and conclusion. The first one is theoretical, including a review of the literature and a formal exposition of methodology. The second is didactic, applying the method to a small model designed to mimic inter-industry interactions between hypothetical countries with different comparative advantages. The third part applies the new methodology to the bilateral trade conflict that arose between China and the USA in 2018.

The data used for the real-case study are the World Input-Output Tables from the WIOD project. The methodology is developed in R language. The source code will be made publicly available in the paper, to foster replication, revision and improvement.

Work is well advanced and I expect the paper to be completed by mid-March.

2. The methodology

The empirical method builds on two interrelated strands of research, both of them based on input-output models. The first one is the "Extraction Method", which has been used in national and regional input-output analysis to identify relevant sectors or regions. Miller and Lahr (2001) provide a review of the different approaches; Dietzenbacher and Lahr (2013) generalize them. A recent application to the regional implications of BREXIT is found in Chen, Los, McCann, Ortega-Argilés, Thissen and van Oort (2017).

The second strand of research is the analysis of "Trade in Value Added". It is closely associated with new dimensions in trade statistics, following the concept of Vertical Specialization proposed in Hummels, Ishii and Yi (2001). One of the pioneering studies along this new line of trade analysis using international input-output models is Daudin, Rifflart and Schweisguth (2009). The first application using official data was published in 2011 by WTO and IDE-JETRO for Eastern Asia. World-wide data bases were developed by WIOD and OECD-WTO and released in 2012.

A recent paper by Los and Timmer (2018) shows that these "Trade in VA" measures can be derived with the method of hypothetical extraction. This paper provided the motivation and the starting point of my work. Indeed, in commenting their approach, Los and Timmer (2018) state page 10 something that is of upmost importance for the present paper: "We would like to emphasize that GDPr*s should not be seen as the GDP level that would result if exports to s would be prohibitive. In a general setting with more flexible production and demand functions,

substitution effects will occur. As a consequence, the total production structure and final demand levels will change and the global production structure after the shock will not be represented by As* and Ysr*. VAXDrs should therefore be regarded as an upper limit of the loss in GDPr* and is most meaningful if compared to other scenarios of extracted transactions".

Follow the suggestion of Los and Timmer (2018), I include substitution effects after extraction to develop a new extraction-cum-substitution method. In this scenario, competitors fill the gaps opened by the extracted industry. At the difference of Computable General Equilibrium models (CGE), the substitution will not result from a complex optimization process; the additional sales will be reassigned in proportion of the existing market shares before the extraction. Actually, the simulation is more akin to analysing the shock from a partial equilibrium approach.

I consider this new methodology as an "exploratory" device that help mapping the relatively unchartered waters of global production network when the weather is stormy. At the difference of CGE models, my proposed algorithm is relatively simple and implementable step-by-step, which allows understanding the mechanism at work. Actually, all the complexity is in today's inter-industrial network (something that is captured by the database) but not in the methodology. As all partial-equilibrium methods, it should be not used for predicting or forecasting, but only as a tool for understanding.

The Evolution Trend and Structural Decomposition of China's Green Value-added: 1978-2017

Topic: Thematic IO analysis: Sustainable Development Goals & Policy Analysis
Author: Jin FAN
Co-Authors: Wan Wei, Xiaohui YUAN

The 40 years of China's reform and opening up to the world is not only a history of rapid economic development, but also a history of environmental pollution and environmental governance: the spread of environmental pollution and initial governance stage I (1978-1992), and intensified environmental pollution and scale governance stage II (1992-2002), and the deterioration of environmental pollution and comprehensive governance stage III (2002-2012), and moderate control of environmental pollution and eco-civilization construction stage IV (2012-2017). This paper explores the evolution trend and structural decomposition of China's green value-added by constructing a non-competitive input-output table for China's environmental pollution from 1978 to 2017. The date used of this paper are based on Chinese Environmentally Extended Input-Output (CEEIO) database (http://www.ceeio.com) and non-competitive input-output table by Chinese Academy of Sciences, and combined with China environment statistical yearbook. The main conclusions are as follows: Firstly, in the course of 40 years of rapid economic growth, the pollution production coefficient has been increasing continuously, and the green value-added index has continued to decrease; Secondly, the structural decomposition shows that investment and exports play a key role in the economic growth of the 40 years of reform and opening up to the world, but with serious pollution problems, especially in stage II and stage III; Thirdly, the pollution generated by the raw material industry (represented by the coal mining and processing industry) and the processing industry (represented by the textiles industry, petroleum refining and nuclear fuel industries) has not been effectively and timely treated. Pollution treatment work of these industries needs to be strengthened in the future.

Demand-driven GHG emissions of Swedish regions: 2008-2016

Topic: Multi Regional Input-Output (MRIO) Models Using Industrial Ecology Virtual Laboratory: Development of Regional IE Lab models and Applications
Author: Futu FATURAY
Co-Authors: Mårten Berglund, Arne GESCHKE, Manfred LENZEN

Sweden is one of the most sustainable countries in the world and has become the best-performing country regarding reducing greenhouse gas (GHG) emissions. In 2016, Sweden's GHG emissions amounted to 5.6 tonnes per capita, the lowest among European Union (EU) countries, which averaged 8.7 tonnes per capita. However, looking at the emissions from the perspective of consumption, the figures look very different, with emissions amounting to 10.1 tonnes per capita in 2016. In this study, we go a step further in the analysis of Swedish consumption-based emissions by looking at the carbon flows between regions. That is, we look at which regions (through their consumption) are driving the emissions in other regions. We do this through multi-regional input-output (MRIO) analysis utilising a new virtual laboratory, the SwedenLab. This new database is able to generate a time-series of sub-national MRIO tables with up to 821 sectors across Sweden's 291 municipalities for the years 2008–2016.

Due to international and inter-regional trade, we found that the consumption of emissions goes beyond basic territorial boundaries. Using an MRIO modelling framework, we are able to identify the emission flows between counties in Sweden and the effect of international trade on regional consumption patterns. Our findings highlight the importance of inter-regional modelling for assessing consumer emissions at the sub-national level.

Using data from household surveys to calculate consumption impacts: why things can go wrong

Topic: Linking micro-data from consumption surveys and IO models: from theory to practice
Author: Esteban FERNANDEZ-VAZQUEZ
Co-Authors: Mònica SERRANO, Antonio F. AMORES

The combination of consumption data from household surveys with the information contained in IO tables is a crucial step to conduct impact analysis related to the effects generated by consumption patterns on the generation of value added, CO2 emissions or energy uses, to mention just some examples. The point of departure of these analyses consist, basically, on connecting the information on consumption made by households with the final demand vector
(or matrix) present in the IO tables, which is then conveniently modified to produce the multipliers of interest. This process requires the construction of a concordance or bridge matrix to make this connection possible, since several issues affect the combination of these two data sources: differences in price valuation between consumption surveys and IO tables, the influence of taxes and margins or the different product classifications between these two frameworks make this combination a challenge for the researcher. Apart from issues regarding correspondences between the two classifications, it is known that data directly obtained from household surveys suffer from other problems: households are inclined to under-report their consumptions of some specific products (the so-called sin consumption) while other consumptions are over-reported (e.g. food). These issues produce inconsistencies between the consumption totals reported in the household surveys with those estimated in the national accounts.

This paper investigate the consequences of not accounting for these issues when using

consumption data on IO models. Basically, we quantify the impacts of final consumption in an IO model when these issues are not controlled and we compare them with those calculated when they are properly addressed. Additionally, we propose several alternative techniques that allow making the consumption totals in the household surveys and in the national accounts consistent. The specific technique applied depends on the amount of additional information at hand. Both research objectives are illustrated by means of numerical simulation and by its application to real-world cases.

Accounting for Global Migrant Remittances Flows

Topic: Thematic IO analysis: Social and Socio-Economic Analysis (on Migration)
Author: Joao Pedro FERREIRA
Co-Authors: Michael L. LAHR, Pedro N. RAMOS, Eduardo Anselmo Castro

Migrant remittances are important to some countries. According to the World Bank, they comprise more than 30% of the GDP of Kyrgyzstan, Tonga, Tajikistan, Haiti and Nepal. Compared to official development aid or foreign direct investment, remittances have lately become a prime income stream for less-developed nations. In this paper, we analyze the net spillover and feedback effects from the consumer demand generated in migrants' home countries. We use World Bank estimates of remittances and the World Input-Output Database (WIOD) for the investigation with so-called "hypothetical insertion" as the tool of choice. We find that even some developed nations, like the U.S., likely benefit from remittances (the largest global path for remittances is that from the U.S. to Mexico), but that not all do (e.g., Canada does not). We stop short of making strong policy recommendations. Instead, we suggest that more attention is paid to the veracity of remittance estimates.

Labour productivity in Hyper-Integrated Subsystems in Brazil: 2000-2016

Topic: Classical IO applications: Industrial economics, Productivity and Efficiency
Author: José Bruno Fevereiro
Co-Authors: Carlos Pinkusfeld Bastos

The aim of the paper is to analyse the sectoral evolution of employment and labour productivity in Brazil between 2000 and 2016. The analysis is realised by employing vertically (hyper-) integrated sectors (subsystems) perspective in the vein proposed by Luigi Pasinetti (1973, 1988). While the use of vertically integrated sectors within productivity studies has been relatively widespread (see, for example, Rampa, 1981; Momigliano and Siniscalco,1982; Ochoa, 1986; Elmslie and Milberg, 1996; De Juan and Febrero, 2000; among others), the development of empirical measures vertically (hyper-) integrated sectors has only recently been developed in recent contributions from Garbelini and Wikierman (2014) and Brondino (2018). This is partially due to data availability constrains as the approach requires the existence Input-Output Matrices (in current and previous year prices), as well as compatible Gross Fixed Capital Formation Matrices, which tend not to be produced by National Statistics Office. Until recently the development of an analysis at this level was unfeasible for the case of Brazil. However, this scenario has changed due to recent contributions by Passoni and Freitas (2018), and Freitas and Miguez (2018), which provide I-O and GFCF Matrices in current and previous year prices at 42-sector disaggregated level. This approach is useful as it is able to capture the interdependent nature of technical change and of the productive process, an insight that partial industry

measures of productivity and traditional sectors activity-based classifications cannot adequately deal with.

Results highlight that, in the upswing (from 2002 to 2008) the share of Manufacturing VIS in employment increased 2 times more than the share of employment in manufacturing sectors of activity. In the downturn (after 2010), while the share in employment of Manufacturing VIS was falling steadily since 2010, employment share of manufacturing sectors of activity only began to fall from 2013 onwards.

Regarding labour productivity, Manufacturing VIS recorded higher labour productivity growth than partial measures of the corresponding manufacturing sectors of activity, such as physical output per worker and value added per workers. While the opposite trend has been observed in Services. This highlights that much of the gain in efficiency in the production of manufactured final demand goods in the period occurred in indirect service activities supplying inputs to the production of manufactured goods. Thus, the idea that services can replace manufacturing as an engine of growth in Brazil may be disregarding the interdependent nature of the economic sectors.

Resilience in a Behavioural/Keynesian Regional Computable General Equilibrium Model

Topic: IO modeling: Computable General Equilibrium Modeling and Social Accounting Matrices
Author: Gioele Figus
Co-Authors: Grant Jordan Allan, Kim Swales, Peter McGregor

Regional resilience can be defined as a region's resistance to, and ability to recover from exogenous disturbances. Martin and Sunley (2015) identify a group of key factors that affect resilience comprising perception, expectation and business confidence. We analyse the role of expectation formation on regional resilience by using a flexible Computable General Equilibrium (CGE) modelling framework. In this instance, the CGE framework is employed as a test bed in order to study the effect of varying a key determinant of resilience in a controlled theoretical and empirical environment.

We develop a dynamic regional CGE with an eclectic, broadly Keynesian, flavour following Joan Robinson, is influenced by the work of Daniel Kahneman in the treatment of consumption and investment. The model can encompass a range of specification in investment expectation formation going from standard neoclassical where agents are perfect foresight, to a setting where investment are made using some heuristics-based process.

The model is calibrated using a 2010 social accounting matrix for Scotland based on Input Output accounts produced by the Scottish Government. To identify the impact of expectations and business confidence on regional resilience we compare the evolution of the regional economy after a temporary negative export shock under a range of investment functions. The subsequent time paths of economic activity are then reported and compared. Our results suggest that expectation in investment decisions is fundamental in determining regional resilience. Specifically, the mainstream neo-classical perfect-foresight form generates a reduction in activity which is small and is limited to the duration of the shock. The heuristic-based, imperfect-information investment models produce more negative, longer-lasting and unstable adjustment paths.

Testing a new approach to estimating interregional output multipliers using input-output data for South Korean regions

Topic: IO Theory: Advances in input-output theory
Author: Anthony T. FLEGG
Co-Authors: Malte JAHN, Timo TOHMO

The multipliers obtainable from a regional input-output (I-O) table are a valuable analytical tool, yet such tables typically must be constructed via non-survey methods. Although Flegg's location quotient (FLQ) is a method that often performs well, it is designed to estimate intraregional intermediate transactions and coefficients. The input coefficients for different regions are estimated independently and interregional coefficients are not estimated explicitly.

A dataset constructed by the Bank of Korea for all 16 South Korean regions in 2005 is one of the few survey-based full interregional I-O tables. It has data for all intersectoral transactions, both within and across regions, thereby allowing us to test some alternative theoretical approaches. Our focus is on an innovative methodological approach proposed by Jahn (2017), in which two methods of estimation, the FLQ and a gravity model, are combined in a consistent way to estimate the intraregional and interregional transactions, respectively. All regions are treated simultaneously. Furthermore, the estimated transactions are constrained to equal the national aggregates for each pair of sectors.

A novelty of our paper is its use of statistical information criteria to determine the best model for estimating output multipliers. Such criteria are relevant when the approaches being compared employ very different numbers of parameters. With the FLQ, for instance, one has a choice between pursuing a simple approach, whereby an unknown parameter δ is held to be invariant across both sectors and regions, and more complex approaches where these assumptions are relaxed. Standard performance criteria cannot reveal whether the inclusion of extra parameters is warranted, whereas information criteria can do so. We demonstrate that, for South Korea, the best approach is to combine the FLQ with a simple trade model. Since the interregional trade flows do not seem to depend much on distances or adjacency, a gravity model is unnecessary.

IMPACTS OF AGRI-FOOD POLICY ON ECONOMY AND WATER ENVIRONMENT: THE CASE OF EXTREMADURA, SPAIN.

Topic: IO modeling: Computable General Equilibrium Modeling and Social Accounting Matrices
Author: Alberto Franco Solís
Co-Authors: Xueqin Zhu

Nowadays, certain highly subsidized agriculture activities have a great impact on the natural environment. Knowledge of the environmental impacts of the removal of these subsidies and how to introduce tax policies tackling environmentally damaging activities provide valuable information for the analysis of agricultural policy issues. Taking as a case study of a Spanish region, Extremadura, the aim of this paper is to study the dependence of the economy on these subsidies and their effects on the water consumption of the region. To do so, we construct a regional Social Accounting Matrix with Water Accounts (SAMWA) with disaggregated data for agri-food industries. This SAMWA is used to develop and calibrate an Applied General Equilibrium (AGE) model following the Negishi format in order to evaluate the environmental implications of changes in the farm subsidies. First, we analyze the economic and environmental impacts of a removal of these subsidies. Second, we consider the maintenance of these farm subsdies on those most demanded agricultural products by the foreign sector, whereas a tax is applied on those agriculture products consuming more water, namely animal products. Finally, we evaluate

a change in the consumption habits of households toward a healthier food consumption based on more sustainable plant-based food (vegetables and fruits) together with the maintenance of the subsidies on the fruits-vegetables and the tax on the meat.

The Choice of Multi-Regional Input-Output Tables in CGE-Models

Topic: IO modeling: Data choices for IO models
Author: Oliver M. Fritz
Co-Authors: Bartlomiej Rokicki

Spatial CGE-models are widely used for simulating impacts resulting from economic policy changes, larger scale investment projects and other kind of economic "shocks". They rely on more or less spatially and / or sectorally disaggregated multiregional input-output tables. While national input-output tables have become widely available in recent years, provided by national statistical offices, tables on a regional scale are still scarce. They are usually estimated based on the information contained in the corresponding national tables; the extent of regional data used to derive these tables varies considerably. Two different views on how much effort researchers should make and how much regional information they should collect or estimate when compiling such tables have emerged: Some argue that rather simple regionalization algorithms are sufficient when regional input-output tables are to be embedded in other types of models, for example CGE-models. Researchers should concentrate their efforts on calibrating the model and in the course of doing so change the underlying regional tables if simulation results seem implausible. Others, however, argue instead in favor of maximizing regional information in the process of table compilation.

The paper at hand attempts to produce some empirical evidence pointing in one or the other direction applying two spatial CGE models for Austria. These models differ only with respect to the system of multiregional input-output tables they are based on: While one system has been compiled based on an algorithm using the national input-output table for the year 2011 and little, but freely available regional information, the other system fits the "hybrid" type of regional input-output tables: While it is based on the same national table for Austria, it makes use of a wide range of data reflecting regional differences in private and public consumption, investment and exports on the demand side and in production structures on the supply side of the table. Various simulation scenarios are carried out applying these two CGE-models to shed light on the empirical relevance of the choice of multiregional input-output tables embedded in the models.

CARBON FOOTPRINT REDUCTIONS SCENARIOS FOR AUSTRALIAN CITIES VIA INDUSTRY STRUCTURE SHIFTS ACROSS CITIES BASED ON NOVEL LINEAR PROGRAMMING OPTIMISATIONS

Topic: Thematic IO analysis: Sustainable Development Goals & Policy Analysis
Author: Xue FU
Co-Authors: Guangwu Chen, Guangwu CHEN, Thomas O. WIEDMANN, Ortzi Akizu Gardoki

Industry structure shifts contribute to carbon footprints relocation that could be integrated into carbon-reduction action. After the theory of industry adjustment is firstly presented in America and Japan, a practical application of long-term national planning IO-LP model in Japan is a necessary complement to market-oriented economies overall. Most IO-LP models study resource allocation, waste management and micro energy decision in developed and less-developed countries. Optimal industry shifts along with decision of changes in industrial carbon intensity and

technology coefficients serve as accurate guidance for cities' carbon reduction action. Yet a clear industrial scheme meeting three principles simultaneously are not made by traditional analysis that explains emissions' drive and responsibilities. Here we develop novel inter-cities IO-LP models based on 2009 Australia inter-cities input-output table (IOT) earliest transferred from inter-cities supply and using table (SUT) to address optimal industrial shifts over cities attempting both growth and emissions reduction goal and decomposition of cities' industrial carbon budgets. Our IO-LP model is novel as the first practice of industry adjustment related to reduction in emissions in developed countries and inclusive of emissions constraints that CGE model is hard to do, and also avoids the corner solution that other optimal models may meet. To overcome the limit of infeasible solution in normal optimization, it presents a two-tier IO-LP model. A multi-dimension recursive IO-LP model. Four scenarios help cities to make crucial strategies for an average annual 1.197% national reduction - the greatest decrease in output share by 0.1% for Energy in Melbourne companying 71 million ton emissions for Agriculture in Rest of Australia at the largest reduction by 5.7%, and the highest GDP resulted from Rest of Australia's 10% drop in carbon intensity for Agriculture and that in technology coefficients for Services- rather than solely megacities' energy-related industry emissions reduction in current research. The advantage is domestic final demands no lesser than the original, for which lower exports dependency is trade-off, whereas the forth scenario avoids lower exports if Melbourne's Goods drop 10% of carbon intensity, bringing forth the largest impact on national carbon intensity decreased by 0.6179% compared with other cities' industries.

The Resilience Dividend in Cedar Rapids

Topic: Using IO to Advance Investments in Efficiency, Resilience, and Sustainability
Author: Juan Francisco Fung

Cedar Rapids, Iowa offers a unique case study in planning for increased resilience. In 2008, Cedar Rapids experienced severe flooding. Rather than simply rebuilding, the city of Cedar Rapids is investing in a resilient flood control system, as well as in revitalizing its downtown neighborhood. A Computable General Equilibrium (CGE) model is developed for the regional economy of Cedar Rapids to quantify the net co-benefits of investing in increased resilience, or the "resilience dividend." The resilience dividend includes benefits to the community even if another disaster does not occur. The CGE model combines a broad range of data sets, including firm-level employment and wages and property tax assessments, as well as the US Census' Public Use Microdata Sample (PUMS) and Input-Output tables. To quantify the resilience dividend from the investments in increased resilience, we build a CGE model of Cedar Rapids at two different time periods: one in 2007, before the flooding, and one in 2015, after the flooding and initial investment in resilience. The two models demonstrate how economies that invest in increased resilience respond relative to those that do not. The CGE approach to quantifying the resilience dividend can capture how the benefits of investing in increased resilience are distributed throughout the economy and, therefore, provide an important first step toward making a business case for investing in resilience.

Extending MRIO analysis of energy technologies with dependence and governance aspects

Topic: Thematic IO analysis: Energy and Environment
Author: Ana Rosa Gamarra
Co-Authors: Natalia Caldes Gomez, Gonzalo Escribano, Johan Lilliestam, Lara Lázaro Touza, Yolanda LECHON

Policy makers are currently confronting the challenge of transforming energy systems into more sustainable ones must simultaneously consider the environmental, economic and social implications of any decision they make. Multirregional Input Output (MRIO) methods extended with environmental, socioeconomic and social vectors -such as the Framework of Integrated Sustainability Assessment (FISA), allow analysing the potential effects of energy technologies, strategies and plans in terms of their economic, socio-economic and environmental implications but leave aside other key factors affecting the decision making process such as geopolitical aspects. In an attempt to partially address this missing dimension, this work enlarges the FISA scope by integrating geopolitical import dependence risks.

In this context, our research question is: It is possible to go beyond the social, economic and social implications and simultaneously assess part of the geopolitical risks that any technology deployment or energy policy may entail with the proposed extended MRIO framework? And if so, what are the right indicators or combination of indicators to consider?

To shed some light to this research questions, a review of the state of the art related to the assessment of import dependence and governance is conducted. Then, we propose the development and inclusion of specific indicators for assessing import dependence in relation to governance levels: Based on the geographical concentration of potential suppliers for a given technology that results from a classical MRIO analysis it is considered to develop a dependence indicator. For governance issues, criteria such as political stability, human rights respect, absence of violence, rule of law, corruption, regulatory quality, legislation and policy, and others are considered. When combining these indicators, the proposed framework is able to measure the risks of dependence from countries with low levels of governance that will potentially hinder or endanger the deployment of the technology, strategy or plan under analysis. The paper discusses how this link between the indicators and subsequent risks can be stablished. Next, the proposed framework of analysis is applied to a concrete case study. Finally a discussion on the advantages, limitations as well as added value for decision makers of the proposed extended framework is presented.

Total Factor Productivity and Relative Prices: the case of Italy

Topic: Classical IO applications: Industrial economics, Productivity and Efficiency
Author: Giorgio Garau
Co-Authors: Stefano Deriu

Fontela in his work (1989) set up the distributional rule between economic sectors of productivity gain in the Input–Output context (Total Factor Productivity Surplus, TFPS). TFPS is calculate as the differences between output and inputs, both measured at constant prices. The idea is based on the Input-Output table deflation at current prices, in order to obtain an "unbalanced" table at constant prices, where the difference between total rows and total columns is the TFPS.

Garau (1996) proposed an extension to identify a measure of surplus, called Purchasing Power Transfer (PPT). This measure is given by the productivity gains and the market surplus generated by extra–profits conditions derived from rental position detained by agents, providing information about the degree of non–competitiveness in different markets.

The focus of the work is to compute and explain Fontela's TFPS comparing it with Garau's PPT in Italy for the year 2009-2014. Fontela's model is based on a single deflation of the input-output table at current prices for 2014 using the implicit price indixes, obtained by comparing the values of the input-output tables at current price and at price of the previous year. Garau's model is based on the assumption that prices can be breakdown in competitive prices and in a residual part due to market distortions. Competitive price indexes are estimated using Törnqvist Index Price, and the input-output table of 2014 is then deflated using these and Fontela's model is then re-applied. The part of TFPS generated or absorbed from the economic system is calculated as difference between the first and the second Fontela's model.

In this way it is possible to highlight efficient production sectors and how they transfer TFPS, but also which are sectors in which economic agents are able to change prices more, by improving or distorting the market.

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Impact Assessment of the Changes in the Energy Sources and Efficiency on the Chilean Mining Sector

Topic: Thematic IO analysis: Energy and Environment
Author: Nicolas GARRIDO
Co-Authors: Patricio AROCA, Loreto Bieritz, Juan Pedro EBERHARD, Anett GROSSMANN, Anke M. MOENNIG

In this paper two effect on Chilean copper mining sector are analyzed in a multisectoral, dynamic macro-econometric model. The first effect is the change on efficiency at producing copper as consequences of the lower ore grade and the technological change. The lower ore grade is reducing the efficiency at extracting the mineral from the rocks, whereas the better technology is increasing the efficiency. The second effect is the fall in energy prices due to the change on the energetic matrix that the Chilean government has developed during the last 7 years. These two effects are combined into three scenarios, and in each one of them the effects are studied until the year 2035. It is concluded that the fall in energy price has a dominant effect on the other scenario. Moreover, given the strong interrelationship of the energetic sector the price reduction generates multiple positive effects in all the economy.

Estimating welfare Impacts of de-facto and de-jure state transfers towards financial inclusion across Indian households

Topic: E3-India initiative- Regional solutions for economy and environment
Author: Partha Pratim Ghosh
Co-Authors: Kakali MUKHOPADHYAY

Proposed Special Session
1) Title of the Organised Session:
E3-India initiative- Regional solutions for economy and environment
2) The names and institutional affiliations of the organizers:
Kakali Mukhopadhyay, Professor, Gokhale Institute of Politics and Economics, Pune, India and Adjunct Professor/ Senior Fellow, Department of Agricultural Economics, McGill University, Montreal, Canada

Title of the Abstract

Estimating welfare Impacts of de-facto and de-jure state transfers towards financial inclusion across Indian households
Authors:
Partha Pratim Ghosh, Department of Economics, St. Xavier's College (Autonomous), Calcutta, India
Kakali Mukhopadhyay, Gokhale Institute of Politics and Economics, Pune, India & McGill University, Montreal, Canada.

Abstract

India is one among several countries that have adopted the Sustainable Development Goals

(SDG) in their march towards decent living and economic prosperity. These include targets to reduce poverty and hunger in the country. The Tendulkar Report on poverty estimates in India show that the national head-count ratio has declined from 45.3 in 1993-94 to 21.9 in the year 2011-12. The government has set a target to further reduce the head-count ratio to about 10.9 by the year 2030. The Government of India report highlights the fact that the poverty ratio varies from almost 40 in some states to about 3 in other regions in 2011-12. National targets will therefore have to be met with adequate emphasis on reducing the regional disparities. Accordingly, economic analysis is warranted at both national and regional levels.

Financial inclusion is one of the main instruments for achieving growth and investment commensurate with these targets. The Reserve Bank of India has identified credit flow to priority sectors, financial literacy as well as credit directed to medium small and micro enterprises and strengthening of financial institutions as the basic components of its program of financial inclusion. With this background, the present study proposes to estimate the welfare impacts of financial inclusion at the national and regional levels spread across various sectors of the Indian economy using E3 India dynamic macro econometric model.

"E3_India" is an integrated Econometric Input-Output model comprising economy energy and environment components encompassing thirty two states and union territories spread over thirty eight sectors. Its strength lies in its ability to trace out regional impacts of national policies and vice versa.

It is expected that the current study will provide important insights for policy makers and various other stake holders in the partnership to develop the Indian economy.

Industrial and Regional Analysis in Britain's Brexit debate

Topic: Murals and miniatures: applying social accounting with a very broad brush, and with fine strokes to precious cameos
Author: Hervey Gibson

This paper was first drafted in the period between chaotic scenes in the UK Parliament from December 2018 and the legislated date for the UK to leave the European Union in March 2019. The chaotic scenes included the first time a Government has been held in contempt of Parliament, and the heaviest parliamentary defeat a Government has suffered in the democratic era.

Brexit is the most abrupt large-scale deliberate rebirthing of trade relationships in peacetime. A nation priding itself on naturally conceiving the first Industrial Revolution, is committing to unplanned Caesarean section for another.

This paper examines aspects of debate and analysis in and out of Parliament likely to be of interest to IIOA members. A bare dozen studies of the economic impact of Brexit have been published, based primarily on fairly macro-economic models constructed with broad sectors. Only one study reported a national income increase, and that required heroic prescriptions. Many, including Government and Central Bank studies, were promptly dismissed by factions and press commentators as based on prior prejudice.

Parliament showed, alongside rhetoric, ideology and rowdiness, the manifest concern of almost all Members to reflect the interests and beliefs of their constituencies, which vary widely across

the country. Evidence and measurement were almost absent, and industrial matters were discussed almost entirely in terms of representations made by constituency businesses, lobbying by national businesses and associations, and TV news cameos.

The first part of this paper reviews the studies, their sectoral content where it exists and is accessible, and the relationship of the models they use to input output, computable general equilibrium, social accounting and the like.

The second part summarises our own studies, which are ongoing and will be brought up-to-date immediately before the Conference. We use DREAM®, a very detailed regional economic accounting model of the UK and the Republic of Ireland. DREAM® models > 150 products/industries in >150 localities, and has developed through more than 200 applications over the past twenty years.

Assessing consumption-based carbon emissions for the city of Bogota

Topic: IO modeling: Consumption-based accounting
Author: Enrique GILLES
Co-Authors: Luis A. LOPEZ, Maria Angeles Cadarso, Mateo Ortiz

In this paper we address the environmental dimension of the sustainability for the city of Bogota, from a consumption-based perspective. We are interested on assessing the carbon footprint for the whole city in line with a growing research that highlights the role of cities in climate change and the increasing active role of majors of relevant cities around the world in the fight against climate change. To achieve this goal, we nest an IO table (IOT) for Bogotá, constructed by city authorities in 2012, into the EORA Multi-Regional Input Output (MRIO) and data on international trade from Colombia's office of statistics. This allows us to identify in which sectors and countries emissions are generated as a response of the city final demand and to assess the differences between consumption-based inventories and production-based inventories for the city. Since the cities are rarely self-sufficient, the evaluation of the carbon footprint of the Bogota allows us to differentiate between the emissions that are directly produced in the city, those incorporated in the purchases made to the rest of the Colombian economy and those associated with imports from the rest of the world.

Our preliminary hypothesis are twofold: first, that the carbon footprint of Bogotá is reduced compared to developed cities, consistent with the differences in electrical energy mix, transport systems and income per capita, and second, that imported emissions for this city are relatively low compared to cities which are more integrated into global value chains.

Globalisation challenges for including exports in the supply and use framework: examples from Germany

Topic: Classical IO applications: Trade and GVCs
Author: Susanne Goldhammer

Although already implemented some years ago, the strict application of the principle of economic ownership introduced with ESA 2010 still occupies National Accounts compilers. Globalized production processes do have consequences for the correct inclusion of the exports in the supply and use framework.

This contribution presents the main data sources used for the calculation of the exports presented in the supply and use framework in Germany: foreign trade statistics for goods and balance of payments statistics for services. It recalls the concept of economic ownership and its implications and presents the concrete steps taken in the German supply and use framework.

Starting with the conversion of foreign trade statistics data to supply and use table classifications, we show the treatment of elements included in foreign trade statistics that do not fulfill the concept of economic ownership and we also show how we add additional elements in order to comply with the concept of economic ownership. In this context, we also focus on the treatment of processing and merchanting and present our treatment for travel.

Students commuting choices: Carbon footprint and environmental identity

Topic: Thematic IO analysis: Social and Socio-Economic Analysis
Author: Nuria Gomez
Co-Authors: Pablo Olivos

Environmental issues increasingly concerns society, however consumption patterns do not seem to evolve accordingly. Decisions on consumption are taken based on education, habits, cost and a number of other variables, and they are not easily modified. We focus on this issue by analysing transport consumption for students, and searching for a link between individual environmental identity and transport decisions.

Numerous investigations have shown that different dimensions of identity play a role in the prediction of biospheric environmental concerns, eecological cooperation for obtaining resources and pro-environmental behaviours (Hoot & Friedman, 2011; Olivos & Aragonés, 2014). Positive correlations have been observed between different measures of environmental identity, such as the Connectedness with Nature scale or the Inclusion of Nature in Self Scale, with the general ecological behaviour (Dutcher et al., 2007; Mayer & Frantz, 2004; Olivos, Aragonés & Amérigo, 2011; Schultz, 2001). Our questionnaire analyses to what extend environmental identity determines real everyday commuting decisions.

We do so by carrying out a survey questionnaire to University students that pursues a twofold objective. By asking about their transport decisions and pulling the information on a Multi-Regional Input-Output model, we can calculate the anthropogenic environmental impact in terms of carbon footprint. The questionnaire also focus on the environmental identity of the student, so that it is possible to appreciate whether their transport choices are coherent with their environmental self dimensions.

We also pretend to identify the best option to prompt changes in the individual choices. Clear and straightforward information on environmental impact of consumption decisions is a powerful tool to change habits, otherwise economic penalties can be considered when information on "Wiliness to pay for anti-environmental behaviour" is gathered. Our questionnaire will also allow us to compare both tools.

Unequal exchange in the European Union. The input-output analysis of trade between Spain and Germany

Topic: Classical IO applications: Trade and GVCs
Author: Maria Angeles Gomez-Benitez

This paper is inspired by concerns over the regional trade imbalance in the European Union which is, currently, the largest example of a common market between different countries in the World. The study of trade within in the European Union is a field of interest because trade inequalities not only concern trade relationship between developed and underdeveloped countries but can be significant between developed countries.

The analysis is based on Marxist trade theory. From Arghiri's unequal exchange to Shaikh's theory of absolute cost advantage, Marxist trade literature has argued about how the value of the production is transferred between countries through trade exchange and how the international price formation defines the exchange's conditions. This work focuses on the role played by the organic composition of capital and the wage levels between the trade of developed countries in a common economic area. The challenge of this research is to test if there are transfers of labour values between European countries, particularly from Spain to Germany, considering any differences in both the organic composition of capital and wage levels. This test will be carried out using the available input-output data published by WIOD database during the period 1995-2011, identifying the differences in organic compositions of capital and wages levels for 34 industries in and between both countries.

INTER-REGIONAL INPUT-OUTPUT MODEL FOR THE ECONOMIC EVALUATION OF CLIMATIC PHENOMENA IN CEREAL SUPPLY

Topic: Thematic IO analysis: Sustainable Production, Consumption, Technology and Innovation
Author: Rodrigo da Rocha Gonçalves
Co-Authors: Cassius Rocha Oliveira

The occurrence of climatic phenomena is becoming a cause of concern for cereal agriculture worldwide. In Brazil, the Rio Grande do Sul state is highly representative in the production of cereals, with a participation of around 60% in the national production. In this sense, the objective of the paper is to analyze the economic impacts of the climatic anomalies of El Niño and La Niña on cereal supply in the state of Rio Grande do Sul (RS) and in the rest of Brazil (RB) between 2008 and 2015. The data base used was from the Interregional Input-Output RS-RB Matrix estimated by the Nucleus of Regional Studies (NEREUS), the results come from a supply-side model (I-O) with the breakdown of the Cereals agriculture sector. The greatest positive impacts occurred in the years 2010 and 2013, while the periods with the greatest negative effects were observed in the years of 2012 and 2015. The sectors most impacted were: food, beverages and tobacco; livestock and fisheries, and housing and food services, which are the largest buyers of Cereals. In general terms, in the period the accumulated losses in RS alone were R$ 112 million in production, R$ 24 million in exports and 705 direct and indirect jobs.

Meeting the Paris Agreement and Supporting Sustainability - quantifying synergies and trade-offs

Topic: Planetary Boundaries and IOA
Author: Anett GROSSMANN
Co-Authors: Martin Distelkamp, Mark Meyer

This paper explores trade-offs and synergies between climate goals as foreseen in the Paris Agreement and other sustainable development goals (SDGs) by means of an integrated scenario analysis. Economic, environmental but foremost social and equality impacts of a transition to a low-carbon-society are analyzed from a global and European (based on the GMRIO-model GINFORS) as well as from an Austrian perspective (based on the national IO model e3.at (economy-energy-environment in Austria).

Two scenarios have been defined and numerically projected with the global model GINFORS: the BAU scenario describes the development without further ambitious low-carbon policies until 2050. The COP21 scenario comprises policies and measures inducing changes in behaviour and consumption that support not only the goal to limit the global temperature increase below 1.5 °C but also progress towards more sustainability with regard to other planetary boundaries.

The core experiences from the scenario experiments for the global and European level can be summarized as follows:

• The Paris goal can still possibly be reached, but only if ambitious political and societal changes around the world will arise in the immediate future.

• If climate and resource conservation action is combined, substantial progress towards sustainable consumption and production can be achieved and would lead to economic benefits.

The Austrian model e3.at provides a detailed analysis of the impacts of both scenarios on the sustainability dimensions for the Austrian society until 2050. The policy measures of the global scenario are transferred to Austria and investigated with the e3.at model in more detail. Synergies and trade-offs among the various policy objectives for Austria are explored. The results are specifically useful for a critical discussion of the relationship between the international climate policy and SDG agendas as well as for the identification of strict and socially acceptable mitigation pathways.

"A Comprehensive Comparison of VAT Reforms Under Different Market Conditions"

Topic: IO modeling: Computable General Equilibrium Modeling and Social Accounting Matrices
Author: Ana-Isabel Guerra
Co-Authors: Ferran Sancho

Research Motivation:
As a way to avert the uncontrolled increase in public deficits as a result of the past economic downturn, many European Union Members implemented deep reforms in their respective fiscal systems. These reforms restricted (and even reduced) public expenditure but they also changed the tax structure and increasing the tax rates of both direct and indirect taxes. The taxes most affected by these reforms were those that exhibit the highest revenue generation capacity. In the context of Spain, for instance, the Value Added Tax (VAT) experienced two reforms (the first one in 2010 and the second one, in 2012) that comprised subsequent raises in the standard and reduced VAT rates. A similar reform was undertaken in the context of the Personal Income Tax. In either of the two cases, these reforms did not encompass any changes in the structure of the taxes.

This is the reason why many researchers have argued that these reforms enacted by the Spanish government at that moment were in fact a "lost opportunity" to improve the degree of efficiency of the Spanish tax system. This was specially the case of the VAT reforms. In this regard, some authors (Conde-Ruíz et al. 2015) stress that replacing the three existing VAT rates i.e. the over-reduced, the reduced and the standard VAT rate by a single rate would have increased the degree of efficiency of this indirect tax while boosting its revenue capacity. The statement of these authors lies in the fact that a single VAT rate would reduce the potential substitution effects that makes this type of indirect tax remarkably distorting among the different tax instruments.

Methodology, Data, Research Question(s) and the Novelties of the Research:
Leaving aside the potential distributive effects (at the moment) and following the previous work by Guerra (2018), the goal here is to shed some light on this debate, evaluating and thus comparing the potential effects in terms of efficiency of these two VAT reforms: the actual VAT reform and that proposed by Conde-Ruíz et al. (2015).
In doing so, we carry out an original empirical exercise using a static applied general equilibrium model (AGEM) with a newly data set constructed by the authors from official data: A Social Accounting Matrix (SAM) for the Spanish economy. This original empirical exercise consists in enabling a comprehensive comparison of the effects of the actual and proposed VAT reforms by implementing a two-step simulation strategy. In the first step, we evaluate the actual VAT reform implemented by the Spanish government. In the second one, we introduce the structure of the alternative VAT reform in such a way that the change in the VAT rates is endogenously determined yielding exactly the same amount of public deficit (in real terms) obtained under the first step. This simulation strategy known in the literature as equal yield simulation makes the comparison of the results to be more sensible.
The second novelty of our research lies in exploring the degree of sensitivity of our results with respect to the market conditions assumed in the AGEM: competitive and non-competitive scenarios. Related to this, previous analyses have shown that the potential effects of fiscal policies are quite sensitive to the assumptions behind the supply structure and more specifically to the presence of economies of scale. This type of sensitivity has been explored for labour taxes, i.e. social security contributions (Gómez, 1999; Bajo-Gómez, 2004) but, to the best of our knowledge, this has not been the case for alternative VAT reforms using the equal yield simulation.

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Deflating U.S. Supply-Use Tables

Topic: Better to deflate SUTs but ... how to do it well?
Author: Jiemin GUO
Co-Authors: Thomas F Howells

Over the past decade, the Bureau of Economic Analysis (BEA) has made numerous improvements to the U.S. input-output (I-O) accounts, including full integration of the benchmark and annual I-O accounts with each other and with the national income and product accounts (NIPAs); development of quarterly GDP by industry statistics based on a fully balanced I-O framework; and a shift from a make-use framework to a supply-use framework, as recommended in the System of National Accounts (SNA). BEA's annual and quarterly GDP by industry statistics include real estimates of value added prepared using a double deflation technique based on BEA's supply-use tables (SUTs). However, the SUTs themselves are published only on a nominal basis. User demand for constant-price SUTs has been enormous. This research project responds to this interest by exploring potential approaches to preparing deflated U.S. supply-use tables. The paper gives an overview of the evolution of the U.S. input-output accounts, including recent improvements in the accounts. The paper then describes current methodologies used for generating double-deflated GDP by industry statistics, how those techniques could be leveraged to prepare constant-price SUTs, and how such an approach compares to methodologies employed by other national statistical offices that currently produce constant-price SUTs. The paper further focuses on challenges associated with generating balanced deflated SUTs and maintaining internal consistency to other inflation-adjusted statistics published by BEA.

Structural Similarity Analysis based on the Network Characteristics of Sectors

Topic: Methodological aspects of input-output analysis
Author: Tesshu Hanaka
Co-Authors: Keiichiro Kanemoto, Shigemi KAGAWA

In this study we propose a new analysis framework, called Structural Similarity Analysis (SSA), based on the network characteristics of sectors. In this framework, we first define new indicators of emissions generated through the supply chain network, called attribution indicators, that quantify how a specific sector contributes to the environmental emissions generated in the supply-chain network and evaluate the roles of sectors in supply chains comprehensively. The clustering analysis method based on the attribution indicators yields the structural similarity for a specific sector in the supply-chain complexity. From the results based on the world input-output database (WIOD), we found 9 clusters of Mining and Quarrying sectors and 12 clusters of Agriculture, Hunting, Forestry and Fishing sectors with similar structures. We conclude that in order to reduce emissions caused by a carbon-intensive industry, the country of that industry should refer to the policies of countries that have the same industry with similar characteristics.

Drivers of Energy-Related CO2 Emission Changes in Indonesia: Structural Decomposition Analysis

Topic: Thematic IO analysis: Energy and Environment
Author: Djoni Hartono
Co-Authors: Sasmita Hastri Hastuti, Muhammad Handry Imansyah, Titi Muswati Putranti

Drivers of Energy-Related CO2 Emission Changes in Indonesia:
Structural Decomposition Analysis

Sasmita Hastri Hastuti1, Djoni Hartono2, Titi Putranti3, Muhammad Handry Imansyah4

1Faculty of Economics and Business, Universitas Indonesia, Depok, Indonesia
2Research Cluster of Regional Economic Modeling and Energy Analysis,
Department of Economics, Universitas Indonesia, Depok, Indonesia
3Faculty of Administrative Science, Universitas Indonesia, Depok, Indonesia
4Faculty of Economics and Business, Lambung Mangkurat University, Banjarmasin, Indonesia

Abstract
This study aims to decompose CO2 emission changes between medium run (1990-1995) and long run (1990-2010) in order to identify main drivers of emission changes in sectorial level. Using energy input-output and input-output table, emission changes are decomposed into six factors: energy intensity, carbonization factor, technology, structural demand, consumption pattern effect and scale effect. This model will allow a country to identify the effects of energy consumption, energy mix and production efficiency as direct sources of emission without ignoring their link to the economic structure and the accretion of final demand. This research is the first attempt in decomposing CO2 emission changes in multi sectors in Indonesia due to the lack of literatures on energy related emission changes in Indonesia. This study found that "electricity, water and gas", "construction" and "mining" have become major drivers rising CO2 emission where the accretion of final demand as the main driving factor. Meanwhile, the increased energy intensity causes a considerable impact on emissions in the long run; while technology is a potential factor to decrease emissions in the long run. This study also found that the changes of demand structure on the energy-intensive sectors especially in exports, as well as the increase of demand on "construction" sector in the capital expenditure contribute positively to long-term emissions.
Keywords: Structural Decomposition Analysis, Energy Input-output, Emission Growth, Energy Intensity

Structural decomposition analysis for greenhouse gas emissions from the Construction sector in Australia

Topic: Classical IO applications: Economic Structural Change and Dynamics
Author: He HE
Co-Authors: Christian John Reynolds, John Boland

This research assesses the greenhouse gas (GHG) emissions arising from the Australian Construction sector with changes in Australian economic system in the post-financial-crisis era. The Australian Environmental-Economic Accounts are combined with Australian input-output

tables to construct the environmentally-extended input-output (EEIO) tables for GHG emissions. It illustrates the relationships between economic activities and GHG emission in the Construction sector. Although the total economic output of the Construction sector has increased by 34.78% from 313634 million $AUD in 2009–10 to 422706 million $AUD in 2014–15, both the direct and indirect effects of GHG emissions in the Construction sector have decreased by 24.62% and 31.44%. On the basis of EEIO, the structural decomposition analysis (SDA) method is applied to estimate the driving forces for the changes of GHG emissions from 2009–10 and 2014–15. The Australian Construction sector has been divided into four sub-sectors: Residential Building Construction, Non-Residential Building Construction, Heavy and Civil Engineering Construction, and Construction Services. The Construction Services sector had generated the largest amount of GHG emissions during the period, and the Residential Building Construction sector has the largest total effect for GHG emission. The growth of GHG emissions in these four sub-sectors between 2009–10 and 2014–15 was mainly affected by the Final demand's overall level of economic activity (the level effect). The level effect of Final demand results in the largest increase of GHG emissions in the the Construction Services sector by about 1068 Giggrams. The novelty of the paper is that the SDA method has conducted enabled analysis for the drivers of the change of GHG emissions from these four sub-sectors disaggregated from the Australian Construction sector. Consequently, the detailed analysis for sub-sectors would lead to a better understanding of the causes of GHG emissions. It benefits the policy-makers to design pertinent strategies for the reduction of GHG emissions in the Australian Construction sector.

The carbon footprint of desalination

Topic: Multi Regional Input-Output (MRIO) Models Using Industrial Ecology Virtual Laboratory: Development of Regional IE Lab models and Applications
Author: Michael Heihsel
Co-Authors: Manfred LENZEN, Arunima MALIK, Arne GESCHKE

This study examines greenhouse gas emissions for 2005–2015 from seawater desalination in Australia, using conventional energies. We developed a tailor-made multi-regional input-output-model. We used the cloud-based Australian IELab and data from Desaldata database. We complemented macroeconomic top-down data with plant-specific desalination data of the largest 20 desalination plants in Australia. The analysed capacity cumulates to 95% of Australia's overall seawater desalination capacity. We considered the construction and the operation of desalination plants. We measure not only direct effects, but also indirect effects throughout the entire value chain. Our results show the following: We identify the state of Victoria with the highest emissions due to capital and operational expenditures (capex and opex). The contribution of the upstream value chain to total greenhouse gas emissions increases for capex and decreases for opex. For capex, the construction of intake and outfall is the driving factor for carbon emissions. For opex, electricity consumption is the decisive input factor. Both in construction and operation, we identify the critical role of the electricity sector for carbon emissions throughout the supply chain effects. The sector contributes 69% during the zenith of the construction phase and 96% during the operating phase to the entire emissions. We estimate the total emissions for 2015 at 1193 kt CO2e. It is the first study of desalination, where a comprehensive multi-regional model has been created and used for measuring the supply chain impacts. With the aid of our multi-regional model, we can also present regional impacts for the first time.

The importance of input-output analysis in the Beyond-GDP/SDG process

Topic: Thematic IO analysis: Sustainable Development Goals / Developing countries
Author: Rutger HOEKSTRA

Input-output anlaysis has played an important role in the history of national accounts and the measurement of GDP. Since the 1970s researchers have attempted to create new metrics that measure societal and environmental change "Beyond-GDP". My book "Replacing GDP by 2030" (Cambridge Univeristy Press) describes a process by which a new accounting framework can be created which measures environmental, societal and economic developments as well as distributional aspects. In this proposal, input-output is a crucial component in the quest to create better metrics for society. The strength of input-output is that it provides a robust accounting framework of stocks and flows but at the same time providing a network perspective which is crucial to understanding phenomena such as globalisation and footprints. The overall framework could signal a further strengthening of input-output analysis in the realm of sustainable developments and the SDGs.

The Value-Added in Trilateral Trade among Mainland China, Taiwan and the United States: A Global Value Chain Approach

Topic: Issue in modelling international trade
Author: LIN HSING-CHUN
Co-Authors: Ching-Cheng Chang, Shih-Hsun Hsu

The issue of trade imbalance between Taiwan, the U.S. and China, which are concerned by all walks of life today, is based on the results of traditional trade statistics. However, the traditional trade statistics method is "gross" statistics, which is different from the "net amount" of GDP statistics. As a result, the increase in the amount of foreign trade in a country does not necessarily mean that GDP has risen, causing an overestimation of the contribution of exports to GDP, and distorting a country's presentation of external competitiveness. This article will clarify the true situation of the trade between Taiwan, the United States, and China from the perspective of the added value trade and trade in value-added. Although the results obtained by the two methods of estimation are different, the results of both countries tend to be consistent when one country agglomerates all its trade counterparties and industrial sectors. Just as in the taxation theory, the economic end-result (metaphor for value-added trade) and the legal end-result (for example, trade in added value) are summed together and equal to the total tax.
The value-added of Taiwan's additional value is far less than the current total amount of statistical exports, among which the value of Taiwan's value added to U.S. exports as a percentage of Taiwan's GDP shows a declining trend and represents a decline in Taiwan's economic dependence on the United States. On the other hand, the value of Taiwan's added value to China as a percentage of Taiwan's GDP is on the rise, reflecting the increasing dependence of Taiwan's economy on China. However, Taiwan's added value to the United States is slightly higher than that of traditional trade statistics. Taiwan has surpassed the United States. Taiwan's added value to China is far lower than traditional Taiwan's surpassing China. There are different trends. It is mainly Taiwan's exports to China, many of which are assembled and processed and then exported to the United States. Finally, the United States "adsorbs" the added value created by Taiwan. As a result, Taiwan's added value to the United States exceeds that of traditional statistics, which is an added value outperformed the traditional low.
The results indicate that Taiwan's exports are mainly for foreign OEMs, and key original

components rely on imports, resulting in a higher share of foreign acquisitions. A closer look at the source of the domestic value-added of Taiwan's exports is mainly due to the export of middle goods, and the proportion is increasing. On the contrary, the proportion of the final goods exports has gradually declined. Among them, the export to the United States was mainly from the final goods exports before 2004, and it was transformed to mainly middle goods exports after 2005. As for Taiwan's exports to China, the proportion of exports from middle goods has been higher in the past 15 years. This shows that Taiwan's industry is participating in global value chain activities and moving to the upper and middle streams. Comparison of Taiwan to the United States and Taiwan to China's VAX and DVA, Taiwan's actual added value earned from the United States is greater than the apparent the United States paid. This is because the United States has absorbed the US's bilateral trade exchanges from Taiwan and the United States. Also, VAX is larger than DVA because the added value created by Taiwan is invisible in other countries' exports to the United States, and the United States also indirectly absorbs the added value created by Taiwan through other countries. Secondly, the added value that Taiwan earns from China is less than China has apparently paid to for Taiwan. The main reason is that part of the added value that China has paid to Taiwan is passed on to other countries, and the United States is the main absorbing country. This shows that China is an important processing and transfer station for Taiwan's exports to the United States.

Demystifying the Contribution of Real Estate Sector in China Using the Input-Output Model

Topic: Structural Change and Economic Growth
Author: Yongming HUANG
Co-Authors: JAMAL KHAN, JIANG ZELIN

Real estate sector in China has a preponderant role in its rapid economic growth and is one of the inevitable components of the whole national economy in recent decades. Using Chinese input-output tables over the period 2002, 2007 and 2012, this study attempts to elucidate the linkage of the real estate sector with the rest of the economy, and further probes the sources of the growth of the sector. In doing so, the paper employs the structural decomposition analysis based on the RAS deflated input-output tables and applys the input-output multiplier product matrix (MPM) to measure and visualize the industrial structure change in the economy.
Results of the decomposition analysis reveal that the output of real estate sector has considerably increased in 2007-2012 as compared to 2002-2007. The domestic demand remains a dominant source of output growth in both the periods with a higher magnitude in the latter period. Also, the real estate sector has lost the advantage of technological and exports effect, and landscapes indicate a substantial variation in the linkages between the sectors. Furthermore, the left causative matrix analysis suggests that more endogenised real estate sector with smaller feedback from non-real estate sectors during 2002-2007 has become more externalised with more substantial feedback effect from non-real estate sectors during 2007-2012. Finally, transportation, Research and development, wholesale and Retail Trade, services to households and other Service sectors have a higher demand for the real estate sector in both periods.

How incentives for skilled-workers stimulate economic performance and employment level. Evidence from a CGE analysis.

Topic: IO modeling: Computable General Equilibrium Modeling and Social Accounting Matrices
Author: Giancarlo Infantino
Co-Authors: Rosita PRETAROLI, Francesca SEVERINI, Claudio SOCCI, Jacopo Zotti

Over the last twenty years, industrial production in developed countries has experienced a profound transformation with a strong move towards higher digitalization and automation. Although with different magnitudes across countries and sectors, this process had a considerable impact on the sectoral capital-labour ratio and on the skill composition of labour demand (OECD, 2010). While the demand for low-skilled labour shrank (lowering low-skilled wages) high-skilled labour demand more than offset skilled labour supply causing the increase in skilled workers wages (Oesch, 2010). Empirical evidence seems to confirm the complementary between skilled labour demand and capital, and a substitutability between low-skilled labour demand and capital, however the determinants of low-skilled unemployment reduction should be investigated at national and sectoral level.

In this perspective, this article provides a model-based assessment of a specific employment policy for Italy, aiming at reducing the labour cost across sectors according to skills level. The employed model envisages an integrated structure combining a Computable General Equilibrium (CGE) model with a micro-simulation model. The CGE model is calibrated on the Social Accounting Matrix (SAM) for Italy and is the MAC18-CGE Model (Department of Economics and Law - University of Macerata), in which the market of labour is disaggregated according to the types of occupations, formal educational attainment, digital competences and gender and is not competitive. In other words, the rigidity of the market in wages formation contributes to generate involuntary unemployment among the different labour categories. The micro-simulation module allows accounting households' behaviour, which is differentiated according to the personal income tax breaks currently applied in Italy. The CGE model evaluates how the macroeconomic sectoral shock reverberates on the labour demand and ahead on the employment level. Then, the micro-simulation model shows how the changes in macroeconomic variables affect households' behaviour in terms of labour supply and consumption demand.

Participation in the Global Value Chains and Domestic Technology Change: Evidence from Japanese Patent-Firm-Matched Data

Topic: Enterprise-related input-output analysis
Author: Keiko Ito

Today's economies are increasingly interconnected through Global Value Chains (GVCs). In particular, East Asian countries have achieved rapid economic growth and gained their presence as "Factory Asia" in the world economy. Japan has been an important player in the GVC, or "Factory Asia," but in fact, her presence has been relatively declining.

This paper explores how changes in the relative position and degree of participation in the Global Value Chains (GVCs) affect firm innovation activities, focusing on the experience of Japanese firms. We conjecture that firms and industries positioned at the center of complex production networks have access to a greater variety of foreign products embodied with skills and technologies as well as a greater breadth of disembodied knowledge, with greater potential for knowledge spillovers, compared to those at the periphery. Therefore, whether firms and industries sit at the fringes of global production or are tightly knotted at the center of a network is likely to affect economic outcomes, particularly technological capabilities of firms and industries.

The analysis is based on patent-firm-matched data with information on GVC networks for the period from 1995 to 2011. We reflect position within GVCs using measures of network centrality and GVC participation utilizing the OECD Inter-Country Input-Output Tables.

We find that Japan's position in the GVCs has shifted from being the core towards the periphery relative to other countries in the network, i.e. becoming less "central". Our analysis shows that forward centrality tends to be positively associated with innovation activities (measured as the number of patent applications). Being located in the key hubs in GVCs, more specifically being key suppliers, would benefit from knowledge spillovers from various customers and downstream markets.

Hybridising Multi-Regional Input-Output and Life Cycle Assessment models using the Maximum Entropy principle.

Topic: Thematic IO analysis: Industrial Ecology
Author: Arthur Jakobs
Co-Authors: Stefan Pauliuk

Understanding global supply chains of our economy and their environmental impacts is an important step towards a sustainable economy. The two widely used methodologies to study supply chains are the process based Life Cycle Assessment (LCA) and Environmentally-Extended Multi-Regional-Input-Output models (EE-MRIO). Whereas LCA provides high detail at the inherent cost of incompleteness, EE-MRIO provides a high level of completeness but at low resolution. Because of the complementary nature of the two methods, various approaches have been taken to merge the two in a so called hybrid-LCA. Albeit the abundance of hybrid-LCA studies, no scientific consensus seems to exist on how to reconcile the different data types in a statistically sound manner.

Here we present our approach to develop a such statistically based method for the hybridisation of LCA and MRIO data. We employ the principle of maximum entropy, which provides a means to find the least biased estimation of a quantity in an indeterminate system, to reconcile information available at different levels of resolution and on different layers (monetary and physical). We determine the optimal sectoral and product resolution of the hybrid supply chain model given all, but only, the available information and its uncertainty. Moreover, we reconcile the available data at the supply and use table level, which allows us to make consistent modelling choices (also known as constructs or allocation models within the IO and LCA communities respectively), within our methodology.

Unlike existing footprint indicators derived from hybrid methods, this statistical approach will enable us to quantify the uncertainty of the footprints calculated and give quantitative information on where in the supply chain resolution needs to be increased and data uncertainty decreased to improve the accuracy of the footprint.

We currently apply our methodology to the Ecoinvent LCA database and the EXIOBASE MRIO data, although our methodology is not limited to any data or format in particular but aims to provide a statistical basis for any large scale hybridisation project on LCA and MRIO data.

Developing Economic – Environmental Hybrid IO-CGE model for the Danish municipalities

Topic: Modelling Carbon Footprints in the MRIO and CGE frameworks
Author: Nino Javakhishvili-Larsen
Co-Authors: Albert Kwame Osei-Owusu

Developing Economic – Environmental Hybrid IO-CGE model for the Danish municipalities.
Author. Dr. Nino Javakhishvili-Larsen, Head of Regional Model, Centre for Regional and Tourism Research, Denmark. njl@crt.dk
Co-authors:
Irena Stefaniak, Centre for Regional and Tourism Research, Denmark. is@crt.dk
Albert Kwame Osei-Owusu, PhD student, Department of Environmental Science - Emission modelling & environmental geography, Aarhus University, Denmark, akoo@envs.au.dk

Keywords: Multi-regional input-output model, CGE, carbon footprint, environmental-economic hybrid

There are ongoing political and scientific debates regarding pollution from the economic activities and its consequences on nature and society in the global terms. The climate change seems inevitable and the natural resources keep depleting. One of the reasons can be because we lack understanding how to treat the resources and how to decrease pollution without creating economic disasters, hunger and further conflicts. Another reason can also be the fact that we look the environmental issues mainly globally with the national political checklist of solutions, however, we fail to understand that the pollution and utilisation of the resources are result of the locally bounded economic activities and therefore, solutions for the global environmental issues should be studied and solved locally. The aim of this paper is to develop methodological approaches for integrating environmental data to the local economic data and construct multiregional IO and CGE model bottom-up, for small geographical units, such as municipalities in Denmark. The research is based on the Danish Interregional economic model SAM-K/LINE for Danish municipalities. In this mode, the interregional SAM is built on two-by-two-by-two approach, involving two sets of actors (production units and institutions / households), two types of markets (commodities and factors) and two locations (origin and destination). While LINE is based on the Leontief and Miyazawa formulations of the Interrelational Income Multiplier Model that incorporates SAM data input and the two-by-two-by-two approach.
This paper describes the methodology that we use to hybridize the economic cycle of LINE with the emission cycle at the product (commodity) and the municipality (NUTS3) level.
In this paper we explain how we intend to extend SAM-K/LINE model by creating environmental-economic accounting for production and final demand by commodity and geography. This will allow us to study both producer and consumer actions and test how changes in the production at one side and the consumption on the other side can support the reduction of carbon footprint, by maintaining economic growth. Linking the demand-side approach to supply-side approach and developing the economic-environmental hybrid IO-CGE at the local (municipality) level will contribute to the previous similar attempts, which should create better understanding of how to solve environmental issues at the local level in order to save the planet globally.

Price Transmission and Industrial Linkage: A theoretical explanation of inter-sectoral price transmission based on input-output coefficients

Topic: IO Theory: Input-Output Price Model
Author: Xu Jian
Co-Authors: Xuemei ZHANG, Yang Yang GUO, Haoyang Zhao

Price transmission is one of the key issues in both economic theories and policies, but most research of price transmission just depicts some features and phenomena rather than explores the deeper reason lying behind. By using time correlation and cointegration analysis methods, this paper tests the existence and strength of price transmission between 35 Chinese manufacturing sectors from 2007 to 2016. Moreover, this paper, for the first time, raises several theoretical propositions and constructs a possible theoretical explanation of inter-sectoral price transmission based on industrial linkage by using input-output coefficients. Results of empirical tests show that price transmission relations beyond regular upstream and downstream concepts between manufacturing sector exist and the existence, strength and time lag of transmission relations can be explained by input-output coefficients, that is, industrial linkage. Further results show that the type of price transmission between manufacturing sectors is supply-push, which holds true through the whole time period. Conclusions above have values on price prediction as well as policy making about supply-side reform.

Measuring the impact of outward direct investment on home country's employment: The case of China's ODI to the US

Topic: IO Applications: Structural change, trade and dynamics
Author: Qingyan Jiang

China's outward direct investment (ODI) has been growing rapidly in the past few years. Understanding the impact of ODI on home country employment is of vital importance. At present, the research methods are mainly econometric model or input-output technology, however, neither method could consider the change of elasticity of employment to ODI and the interaction effect between industries at the same time. In this paper, a new measurement is proposed based on the state space model and input-output technology. Firstly, the state space model is used to estimate the export-ODI elasticity. Then, based on the calculated elasticity, the input-output model is used to estimate the amount of employment stimulated by the growth of ODI. The models can not only measure the direct effect of ODI growth on employment, but also take lag effect and the interaction effect of various sectors into account. Using China's ODI and export data to the US and WIOT from 2009 to 2014, we did an empirical study and find that: (1) China's ODI of construction industry and information transmission, computer services and software industry have a negative effect on the export, while in other industries there exists a positive effect; (2) The growth of ODI of single sector has a positive effect on the total employment; (3) China's employment induced by the increase of ODI to the US shows a downward trend from 2010 to 2014; (4) The impact of ODI of computer services and software industry on export has a lagging effect.

Exports diversity, income and global value chains: what's behind the current world performance?

Topic: Classical IO applications: Trade and GVCs
Author: Sofía JIMÉNEZ
Co-Authors: Rosa DUARTE, Julio Sánchez Chóliz

During the last two decades globalization has been one of the most important processes in the worldwide economy. This has made country's trade profiles to be in the forefront of economic literature as important drivers of economic growth.
The effect of export variety on economic growth has been a recurrent topic in recent literature. Some papers have found a positive and linear relationship between exports diversity and GDP per capita (Freire (2017)). Other authors such as Cadot et al (2011) claim that this relation is not lineal, achieving a U-shaped pattern. That means that exports diversity would be beneficial for those countries with low income levels but specialization would be prefer when a certain stage of development is already achieved.

Besides, nowadays, global value chains have been increasingly studied in economic literature, showing product fragmentation and international trade as sources of income growth. In this context, at the best of our knowledge, no other papers have analyzed how the participation in global value chains can affect exports diversity and to what extent can be identified regional and/or patterns in this relationship.

Our paper aims to address these questions within a multiregional input-output framework, using as a main empirical database EORA25 (Lenzen et al (2013)). We will use as a measure of diversity the one proposed by Hausman et al (2011) but applied to input-output model. We will run panel data regressions to study the relation between exports diversity and, both economic growth and participation in global value chains, distinguishing from different levels of income. Our preliminary results seem to support the existence of a non-lineal relationship between VA and exports diversity as well as between it and participation in global value chains, suggesting that countries' development is a variable to take into account when to trade policies refers.

Two-stage approach of reconciling trade statistics under the supply–use framework for constructing APEC IOTs

Topic: Compiling and Applying the APEC TiVA Database
Author: Lin Jones

Title: APEC Two–stage approach of reconciling trade statistics under the supply–use framework for constructing APECIOTs
Authors: Lin Jones (U.S. International Trade Commission), Zhi Wang (George Mason University/UIBE) Abstract
This paper summarizes the two–stage approach of balancing trade statistics at global, bilateral, and sectoral levels under the supply–use framework for constructing APECIOTs, the underlying data for the APEC TiVA database.
At the first stage, we estimated missing services trade statistics, and reconciled international trade statistics at bilateral and sectoral levels by end use, so that we could derive trading partners' share for each APEC economy by product and end use.
At the second stage, we reconciled international trade data at global, bilateral, and sectoral levels under the supply-use framework with three sequential models: model 1 balanced trade at the global level, by reconciling official NA estimates of each economy's total merchandise and services trade statistics with total exports to and imports from the world reported in that

economy's SUTs at the product level. Model 1 produces a set of total export and import vectors at the economy and product levels which satisfy the condition that world total exports (f.o.b) plus an international shipping margin (c.i.f.) equals world total imports (c.i.f.). The global supply and use of international shipping margin services are also balanced simultaneously at this stage, similar to the approach in Streicher and Stehrer (2012), but achieved under a unified modeling framework.

Model 2 reconciled single-economy SUTs with the globally–balanced total exports and imports estimates from model 1 through multiple rounds of optimization process. Data inconsistence for a particular economy/year's SUT are pin-pointed, and constraints are gradually relaxed in each round until all data are balanced.

Model 3 integrated reconciled single-economy SUTs from model 2 with balanced trade statistics from stage one, which reconciled trade vectors in SUTs were disaggregated by trading partners with shares estimated from stage one. Each economy's total exports to and imports from the world derived from model 1 are used as total controls, and distributed among trading partners before the final balancing to produce APECSUTs without discrepancies. Finally, the balanced APECSUTs are transformed into Industry by Industry APECIOTs based on the model D assumption of fixed product sales structure (Eurostat, 2008).

The two-stage top-down APEC TiVA approach allows the optimal utilization of information from available official data sources, while ensuring the resulting inter-economy input-output tables to remain close to official NA data to the extent possible.

Mapping effectiveness of Indian COP24 commitments towards low carbon climate resilient sustainable growth trajectory for India

Topic: E3-India initiative- Regional solutions for economy and environment
Author: Surabhi R. JOSHI
Co-Authors: Kakali MUKHOPADHYAY

Abstract:

Alleviating climate change impacts for India entails a binary of climate change mitigation and resilience actions. India has reinstated its commitment to the negotiated 20C carbon space at Katowice recently and aims to execute following climate action plan through the Nationally Determined Commitments (NDCs) by 2030:

i)   Decarbonisation of energy sector by achieving 40% of electric power installed capacity from non-fossil fuel sources by 2030

ii)   Increase process efficiency to reduce the carbon emissions intensity of India's gross domestic product (GDP) by 33% to 35% from the 2005 levels

iii)   Creating carbon sinks of about 2.5 to 3 billion tons

A recent world bank report indicates that climate change impacts are likely to lower the living standards of nearly 600 million Indians i.e. half of India's population . However, limiting warming to 1.5°C makes it much easier for developing economies like India to achieve many Sustainable Development Goals (SGDs) like poverty eradication, water access, safe cities, food security, healthy lives and inclusive economic growth. The study evaluates scope of climate resilient growth linked with the negotiated techno economic transitions under Indian NDC's using E3-India model.

E3-India is an integrated dynamic macro econometric model which captures Economy, Energy and Environment (E3) linkages and allows researchers to assess wide range of economic policies including energy and environment specifically at the state level in India.

The research work involves compiling a matrix of different scenarios by constructing three

pathways i) Business as usual scenario (~RCP 8.5), ii) Committed 20C NDCs, iii) Aspired 1.50C (~RCP 4.5) including combinations of energy decarbonisation, process efficiency and carbon sink development actions.

The socio-economic outcomes of pathways with respect to income generation, employment and government revenue creation are evaluated for several Indian states identified as most vulnerable to climate change in terms of negative impacts on living standards of the population.

This study provides a socio-economic evaluation of the green growth opportunity implicit in the existing NDC targets for India and its distributional implications across Indian states. A study like this will be a crucial base document for formulating state level climate policy in India. The study further demonstrates effectiveness and use of integrated modelling frameworks in regional models like E3-India enabling more informed policy decisions for climate change impact alleviation.

Key Words: Climate resilience, NDC, Energy transition, green growth

A Case of Existence and Non-existence of Trade Equilibrium in The Leontief Trade Model

Topic: IO Theory: Input-Output Price Model
Author: Ujwala Sakharam Kamble

Trade theories are of several varieties: Classical Ricardian, Heckscher-Ohlin-Samuelson (HOS), Krugman engender intra-industry trade theories under increasing returns to scale, and linear trade models of Leontief variety. The paper comes under this last variety of trade theory.

From its very beginnings international trade theory has been formulated in the context of a general equilibrium perspective. The standard protocol has been to first work out the general equilibrium of autarkic economies on the assumption of given endowments, technologies and tastes and preferences. The autarkic equilibrium contains solutions of domestic relative prices and determine the pattern of comparative advantages. Next the international trade equilibrium, if it exists, is worked out to find the international terms of trade and the post-trade outputs of commodities. Finally, derivative results like the welfare gains etc. are extracted.

This paper also follows the standard protocol of international trade theory. However, there are some important departures so far as the assumptions are concerned. Firstly, capital in its value connotation is not considered as an "endowment" in the Leontief-trade model; in other words, the distribution between physical capital and value capital is strictly adhered to. Thus, the paper speaks of the physical endowments of individual capital goods in relation to labour ratios. Secondly, since capital goods are treated as produced commodities, the assumption that the same physical size of each capital good is employed both pre- and post-trade becomes unsustainable. The paper however supposes full employment of labour in the pre- and post-trade situations.

Excepting these departures, the attempt is to mimic as closely as possible the assumption of the standard Heckscher-Ohlin-Samuelson neoclassical trade theory. Thus, the paper supposed that there are two static competitive economies with given Input-Output coefficients and labour coefficients producing two commodities by means of constant returns production functions and consuming them by means of homogenous of degree zero functions that are identical in both countries. After illustrating a case of non-existence of trade equilibrium due to a mismatch between endowments and requirements of labour, it elaborates on Leontief trade theory where trade equilibrium is shown to exists.

A Lifecycle Analysis of the Corporate Average Fuel Economy Standards in Japan

Topic: Thematic IO analysis: Transport & Policy Analysis &
Author: Mitsuki KANEKO
Co-Authors: Shigemi KAGAWA

Due to the increasing severity of climate change, the Paris Agreement was adopted in December 2015 under which countries decided on carbon dioxide (CO_2) emissions reduction targets with the aim of holding the increase in the global average temperature to within 2°C above pre-industrial levels (United Nations Framework Convention on Climate Change: UNFCCC, 2015). To achieve this target, Japanese government will adopt the Corporate Average Fuel Economy Standard (CAFE standard) to reduce the energy consumptions and CO_2 emissions in the transport sector, that account for about 20% of CO_2 emissions in Japan. For this study, we estimated the CAFEs and CAFE targets of seven Japan's domestic automobile manufacturers and evaluate whether manufactures have achieved these estimated CAFE targets. Furthermore, we proposed an analysis framework for estimating what impact the introduction of the CAFE standards in Japan will have on motor vehicle-derived lifecycle CO_2 emissions including the manufacturing, driving, and disposal of vehicles. We estimated the life-cycle CO_2 emission intensities per passenger vehicle in manufacturing, during travel, and in disposal were estimated using the Embodied Energy and Emission Intensity Data for Japan Using Input-Output Tables. Moreover, we estimate the utility of the holding vehicles. As a result, we found the following: (1) automobile manufacturers can maximize their sales under the constraints of the CAFE standards, but vehicle sales plans based on sales maximization will lower their CAFE standard scores. (2) Economically optimal automobile manufacturer behavior—striving to achieve CAFE standards while maximizing sales—will increase the manufacturers' overall carbon footprint and actually worsen the environment. Even though, based on the estimated optimal sales patterns for each company where fuel efficiency for the vehicle models sold is improved 20%, the overall carbon footprint for all seven companies would be approximately 53 million tons, a 1.2-fold increase over their 2015 carbon footprint.

Edge Clustering for Supply Chain Networks

Topic: Methodological aspects of input-output analysis
Author: Keiichiro Kanemoto
Co-Authors: Tesshu Hanaka

The companies are seriously concerned at the environmental risk in their supply chains as well as their production. Interindustry collaboration is essential to reduce supply chain emissions. However, the supply chains continue infinitely and an enormous number of companies are involved in the supply chains. Some studies suggest structural path analysis (SPA) for finding environmentally important supply chains, but the identified paths cover a relatively small amount of emissions. In addition, node clustering could suggest how an industry team up with other industries for reducing environmental risk. In node clustering, however, the industry could engage in only one industrial collaboration due to grouping industries. This is inconvenient for some industries like the electricity generation industry because these industries produce goods and services for almost all industries or use many kinds of goods and services for their production. Here, we suggest a new clustering approach, called edge clustering, for input-output analysis. The concept of edge clustering is to group transactions rather than industries, and therefore an industry could belong to more than two clusters. The new approach helps the

companies to find collaborators for lowering the environmental risk in supply chain networks.

An Overview of the Optimal Input-Output Planning Model and Cross-Boundary Information System of Economic Management

Topic: Classical IO applications: Industrial economics, Productivity and Efficiency
Author: Ning KANG

Title: An Overview of "The Optimal Input-Output Planning Model and Cross-Boundary Information System of Economic Management"

Abstract: Cross-boundary, the key word of IT industry in 2010 which swept down from upstream industries to downstream terminals, PC, software, internet... no exception in all areas. With the combination of mobile and internet, a revolutionary change has been brought along. However, the superiority of traditional domain can not remain mighty in new area. The secondary cross-boundary is to use mathematical tools provided by the thinking mode of discrete mathematics and continuous mathematics as a theoretical basis of cross-boundary economic management information system. It is a scientific method for promoting the integration of the optimal input-output planning model, Big data, new technology of cloud computing and new industry of internet and Internet of Things. With the secondary cross-boundary, everything will be able to reach its limit regarding area, scale, strength and efficiency. With "The Nine Must" linear model 〖Note〗, it will not only improve the modern management of the organisations all over the world, it will be important measures for the overall governance as well; it will not only be a scientific basis for creating a harmonious society such as a one world society with justice, fairness and mutual benefit, but it will also be able to completely avoid resources waste and corruption. In this article, a brief description will be given only for the realisation of the real-time analysis of the optimal input-output planning model and the timely analysis of input-output statistical model.

An Framework Based on Input-output Model for Warning of Overcapacity

Topic: IO Data: IO and micro data
Author: Ji Kangxian
Co-Authors: Jing He, Xu Jian

Overcapacity has been plaguing China for many years. For now, however, there is no mature and universal framework for warning of overcapacity. This research constructs a comprehensive yet relatively concise framework based on IO table for warning overcapacity by including two indicators measuring the relative growth rate of the production capacity and the change of capacity utilization. As an example, China's 15 heavy industry sectors are being analyzed under the above framework. The main contribution and innovation of the research is building the applicable framework for warning overcapacity.

Regional Trade and Economic Development: Options for Pakistan

Topic: IO modeling: Computable General Equilibrium Modeling and Social Accounting Matrices
Author: Muhammad Aamir KHAN

Pakistan shares its northern border with the People's Republic of China, while it shares part of its northern, eastern and southern border with India: the second and seventh largest economies in the world respectively. Pakistan should therefore be ideally positioned to gain from liberalization of trade. The Pakistan-China Free Trade Agreement (FTA) signed in 2006 came with expectations of exclusive concessions and advantages towards Pakistan, but the benefits from Pakistan-China FTA are considerably less than first anticipated. Pakistan's domestic producers suffered a huge blow as they could not compete with cheaper imports, particularly from the ASEAN economies who subsequently received more concessions from China as part of the ASEAN-China FTA. More recently, the Ministry of Commerce has begun negotiations with India to sign a Non-discriminatory market access agreement (NDMA). Proponents of Pakistan granting India NDMA status maintain that both countries stand to gain increased access to one another's vibrant markets after years of restrictive policies and disproportionately low trade relative to their trade with other countries.

Given this new backdrop we analyze the impact of the Pakistan-China FTA and the possibility of trade normalization with India, and consider what changes could be made to these agreements to improve the outcome for Pakistan. A global Computable General Equilibrium model is used to include more detailed information on Pakistan, India and China's labor and household groups into the latest GTAP database using MyGTAP approach (Walmsley and Minor, 2013). This allows for a more detailed analysis of the impact of the different regional integration scenarios at the household level. The current Pakistan-China FTA shows a negative impact on Pakistan economy, however when the preferences are increased in line with the ASEAN-China FTA the overall impact on Pakistan is positive, at both the macro and micro level. Normalizing trading relations with India, through granting India NDMA status with better trade facilitation and full implementation of South-Asian Free Trade Agreement (SAFTA) simulation result show positive impact on the Pakistan economy, while also raising real GDP in India, thereby offering a win-win solution for both parties. The report concludes that the gains to Pakistan from normalizing relations with India with better trade facilitation are much larger than those from the FTA with China.

Development of U.S.-East Asia Financial Input-Output Table

Topic: Global Flow of Funds Data and its Applications
Author: Jiyoung KIM
Co-Authors: Satoru HAGINO

To get a brief overview of the world economy in recent years, savings glut causes public debt problem in developed economies. On the other hand, lack of investment undermines economic growth of underdeveloped countries. However, the discrepancy of financial systems between developed and developing countries hinders global redistribution of funds. To analyze the global economy, both of financial and real sectors should be considered. In fact, financial transactions and trades are two sides of the same coin. Financial transactions between multiple countries present the global financial market, whereas international trades reflect the real economy. As is well known, international input-output tables, which indicate the real sector, has been developed. However, statistics for international financial transactions, namely financial input-output table, is as yet undeveloped.

 Firstly, the main purpose of this paper is to comprehend and organize flow-of-funds accounts of various countries of the world from the financial point of view. Especially, we construct the global financial input-output table which shows both international and domestic transactions by each domestic institutional sector for the U.S., Japan, Korea and China.

 Second, we analyze the table applying input-output method. We calculate power of dispersion indices in asset-oriented system and liability-oriented system to compare the roles in the global financial market.

Demographic and income heterogeneity household Input-Output model: consumer behavior in a transition economy

Topic: Classical IO applications: Industrial economics, Productivity and Efficiency
Author: Kwang Moon Kim
Co-Authors: Norihiko YAMANO, Bui Trinh

The dynamic structural changes in demographic and income disparities across different household groups observed for last decades in both developed and emerging economies. While the household structures reflect ageing society in developed economies, in emerging developing economies, on the other hand, the decreases infant and elderly mortality, number of children and emergence of the middle-income group result the changes in consumption behaviors. This study extends a conventional national Input-Output system by introducing the heterogeneity behavior in the final expenditure items by the integrating the surveys on household demographic and income discrepancy information for a relative statistics scarce economy (Viet Nam). Our extended I-O system enables to measure the domestic economic impacts of the structural changes observed in household structures for the period between the mid-2000 to the mid-2010s.

Decomposition of Lifecycle CO2 Emissions Associated with International Flights of the Japanese Airline Industry

Topic: Thematic IO analysis: Energy and Environment
Author: Minami Kito
Co-Authors: Fumiya NAGASHIMA, Kayoko SHIRONITTA, Shigemi KAGAWA

International Civil Aviation Organization (ICAO) has decided a concrete plan to reduce CO2 emissions from international airline industry after 2021. The plan set the CO2 emissions for a specific airline company, therefore it is crucial for each airline company to decrease the CO2 emissions from their long-distance flight activities. Previous researches focused on the CO2 emissions from airline industry at country level (e.g., Lenzen et al., 2018), however they didn't analyze the CO2 emissions affected by flight schedules . The previous studies have a limited understanding of how airline companies manage the international flights and reduce the CO2 emissions through modifying the flight schedules. To address this important question, we focused on two major airline companies of Japan, Japan Air Lines (JAL) and All Nippon Airways (ANA) and made a comprehensive database including timetables for their international flights, number of international flights per week, air plane used for each international flight, round trip distance for each international flight, and fuel efficiency of the air plane used for the international flight. Using the database, we estimated the lifecycle CO2 emissions associated with the international flights of the two airline companies in 2005, 2010, and 2015. The result shows that the CO2 emissions for the JAL decreased by 4.1 Mt-CO2 between 2005 and 2015, whereas the CO2 emissions for the ANA increased by 3.8 Mt-CO2 during the same period. For the ANA, the decomposition analysis

revealed that changes in total number of international flights was a major driving force to increase the CO_2, whereas CO_2 reduction effects through improvements in fuel efficiencies of airplanes used in the international flights was relatively small. We conclude that it is important for the Japanese airline industry to make a greener flight plan by considering a relationship between the major driving forces crucial for mitigating CO_2.

The role of embeddedness on regional economic resilience

Topic: Classical IO applications: Economic Structural Change and Dynamics
Author: Tasos Kitsos
Co-Authors: Andre Carrascal

The 2008 crisis has been the focus of a range of fields within social sciences. Regional economists and economic geographers have predominantly focused on the varying degree of impact on places and regions within countries. As a result, the notion of economic resilience, namely as the capacity to overcome or avoid the negative effects of a downturn, has been brought to the centre of attention. Since then, numerous contributions have identified some of the determinants of economic resilience, leaving the embeddedness of local economic systems relatively unexplored due to data constraints.

This paper examines the effects of local economic embeddedness on the resilience performance of UK NUTS2 regions during the 2008 crisis by means of different measures that show the nature and incidence of the domestic production. It is hypothesised that embeddedness can lead to positive externalities through economies of complexity and enhance resilience performance, especially during recessions. Concurrently though, increased embeddedness can lead to lock-in effects and reduce the above effects for higher levels of embeddedness.

To test these hypotheses, the paper utilises the new regional input-output database EUREGIO (Thissen et al., 2018) to approximate the embeddedness of local economies in UK NUTS2 regions. The level of embeddedness is then used in a panel data examination to identify whether more embedded economies have performed better during the crisis and whether these effects are monotonic or not. Preliminary results point to a complex non-linear relationship between the above industrial structure characteristics and economic resilience to the 2008 crisis.

Keywords: Input-Output, economic resilience, domestic multipliers, regional economies

Uncertainty Analysis with Consideration of Correlation between the Elements of Input-Output Table

Topic: Methodological aspects of input-output analysis
Author: Yasushi KONDO
Co-Authors: Jian Jin

Despite its necessity and importance, the reporting of uncertainty indicators, such as standard deviation and confidence interval, is uncommon in input-output analysis (IOA). The Monte Carlo method has been widely used in IOAs for performing uncertainty analysis (Bullard and Sebald, 1988, Rev. Econ. Stat.; Lenzen, Wood, and Wiedmann, 2010, Econ. Syst. Res.; Rodrigues et al., 2018, Environ. Sci. Technol.). The Monte Carlo method can be applied to quantify the uncertainty indicators in an IOA if a joint distribution of the elements of an input-output table (IOT) or an

input-coefficient matrix is specified. Normal, gamma, and log-normal distributions are examples of popular specifications. While the elements of an IOT are mutually correlated by construction, a common practice is to employ the independence assumption, according to which the elements of an input-coefficient matrix are independently distributed. Rodrigues et al. (2018), which is an excellent study of the uncertainty of consumption-based greenhouse gas emissions, is an exception; the method used in it to consider the correlation between the elements of an IOT is valid when multiple IOTs are observed. However, it is quite likely that only one IOT is observed for a wide range of IOAs. Given this background, this study proposes a method to evaluate the uncertainty in an IOA under the reasonable assumption of a joint distribution of the elements of an input-coefficient matrix. Our method is feasible even when just one IOT is available. At the conference, we will explain how the proposed method works by focusing on the difference in uncertainty between the cases where the independence assumption is used and those where it is not.

Growth and Final Consumption in Brazil from 2000 to 2016: a Structural Decomposition Analysis

Topic: Classical IO applications: Economic Structural Change and Dynamics
Author: Camila Unis Krepsky
Co-Authors: Esther Dweck

The objective of this research is to understand the household consumption and economic growth trajectories in Brazil, between 2000 and 2016. We try to understand the sources of the structural change observed and identify the presence of cumulative causation processes between consumption and production structure. We performed two structural decomposition analysis (SDA): one for households' consumption growth and another for gross output growth. The first provides a measure of the contribution of changes in one exogenous component and four endogenous components – the propensities to consume, average wages, labor productivity and output growth. Likewise, the second decomposition will measure the contribution of the changes in the components of the aggregate demand on output growth for each economic activity. The novelty of this study is the application of the structural decomposition analysis technique to the household's consumption variation. We also improved the methodology used in former works to endogenize consumption. We used a series of I-O matrices valued at constant prices constructed by GIC-UFRJ for the period 2000-2016. We also used data related to the wages and occupations by industry from the Brazilian Annual Industrial Survey (PIA), and several classifications made available by IBGE. We found that structural change in output and consumption reinforced each other in the periods of economic expansion and observed the high relevance of investment and government spending in the determination of the economic cycle.

Carbon Footprints at the Regional Level and Why They Matter

Topic: IO modeling: Consumption-based accounting
Author: Tobias Heinrich Kronenberg
Co-Authors: Johannes TÖBBEN

Carbon footprints have become an important tool in sustainability science. They can be used to communicate the relationships between the final demand for goods and the carbon emissions that are associated with that demand along the supply chain. With the help of carbon footprints, we can shed more light on the environmental consequences of economic decisions by households

and firms. At the national level, carbon footprints can contribute to the design of better policies that can make societies and economies more sustainable (or at least less unsustainable).

Carbon footprints are calculated on the basis of input-output tables and satellite accounts that reflect the amount of carbon emissions by industries. In most cases the data is available at the country level – either from national statistical offices or from MRIO databases such as WIOD or EXIOPOL. This methodology relies on national averages. Hence, it cannot account for differences in consumption patterns or production techniques within countries. For many applications, the use of country-level data may be appropriate. However, in some cases the difference between regional and national economic structures can be significant. We illustrate this issue with the case of North Rhine-Westphalia, a NUTS1 region in Western Germany.

As one of the 16 German Länder, NRW has its own regional government and parliament (Landtag). Consequently, it has its own climate policy and sustainability strategy. The regional sustainability strategies of the Länder are not always in line with the national sustainability strategy of Germany. For example, the national sustainability strategy wants to reduce greenhouse gas (GHG) emissions by 40% between 1990 and 2020. NRW, by contrast, has a target of 25%. Moreover, policy measures that contribute to sustainability at the national level may have adverse effects in certain regions. Currently, for example, Germany is debating a phase-out of coal energy. This measure would clearly bring down national GHG emissions, but it would have serious consequences for employment in the regions with (currently) active coal mines, NRW being one of them.

When regional governments design their sustainability strategies, they should be able to assess the overall effects of their policies. These effects do not stop at regional administrative borders. The economy of NRW is closely intertwined with the rest of Germany and of course with the rest of the world. Hence, regional sustainability strategies may trigger spillover effects in other regions.

The goal of our paper is to contribute to the study of these spillover effects. We use the global MRIO table from the WIOD (with 44 regions/countries) and divide Germany into two regions: NRW and the rest of the country (ROC). As a result, we obtain an extended MRIO table with 45 regions/countries. The extended MRIO makes it possible to compute carbon footprints for NRW and ROC individually.

At present, we are still in the final stages of constructing the extended MRIO table. At the workshop we plan to present preliminary results that illustrate the differences between the carbon footprints of NRW and Germany as a whole.

Evaluation of Knowledge Stocks of R&D Expenditures as Intangible Assets on Static/Dynamic TFP Measures by Input-Output Framework

Topic: Mathematical Analysis and Thematical Applications
Author: Masahiro KURODA
Co-Authors: Michael C. HUANG

In the 21st century, the world has confronted substantial structural change from a top-down vertical division labor system to a flat and interconnected platform. Such change may drastically reconstruct the former production structure which were desirable so far. Since 2011, Japan's ministry of education, science & technology (MEXT) has proposed a 15-year project called Science for RE-designing Science, Technology and Innovation Policy Project (SciREX) to make evidence-based R&D policy evaluation. For making references for policy options, the SciREX Policy Analysis Intelligence System (SPIAS) was constructed with the following functions: i) SPIAS-β, a comprehensive R&D data-base consists of inputs (funding), research results, patents

and productivity index by industry; ii) SPIAS-c, which try to make policy scenarios based on the data of SPIAS-β that linked by production efficiency parameters by industry; iii) SPIAS-e, an economic simulator to project the alternative policy options of the impacts on industrial sectors as well as macro economy during the year 2020-2050.

In this research, we compiled Japanese input-output table in which R&D expenditures were internalized as intangible capital investment, enabling the evaluation on intangible assets as knowledge stock by quantity and quality measures. By the process, R&D investment by government as well as industry that contribute to static/dynamic total factor productivity (TPF) improvement could be observed and coped accordingly to determine the production efficiency improvement by industry through industry linkage.

Finally, the simulation results of macro and sector indicators such as GDP, wage rate, fiscal deficit, working hour, price index, etc. will be shown the possible consequences of R&D expenditure under Japan's severe condition of aging society and shrinking population. It is to be stated that the purpose of such economic model does not serve for economic forecast, rather, the projection of economic indicators provides information about the change on socio-economy with implication of technology input and other policy measures to accommodate the structural change for obtaining sustainable development in a new social style.

Expansion of green industries in Zambia: Short and long-term effects

Topic: Construction and applications of the 2010 SAM for Zambia
Author: Massimiliano LA MARCA
Co-Authors: Xiao JIANG

Zambia produces most of its energy from large hydropower stations. The sector has been expanding in recent years, yet the country faces the problems of power shortages and high energy price that is often unaffordable by the vast majority of people and business. Investments in smaller stations are currently underway, which are expected to turn the current power deficit into surplus. The paper presents alternative economy-wide impact assessments of the expansion of hydropower industry in Zambia. The 2010 SAM produced by the national statistical office and ILO distinguishes between 20 industrial branches and has a breakdown of selected "green industries" based on the System of Environmental-Economic Accounting (SEEA) and the Environmental Goods and Service Sector (EGSS). Among these green industries, green energy production in the form of hydro-power stands out for its potential impact on other industries and household incomes. SAM multiplier analysis on quantities and prices are first carried out in isolation to estimate the demand and price push effects of installation and maintenance and increased supply. Such effects are then compared with the results of increased capacity in the green energy sector and investment demand using a full structuralist CGE. The expansion of the hydropower sector is simulated under alternative assumptions on the supply elasticity parameters as well as in a static or recursive dynamic setting to investigate the possible difference between short and long run economy-wide effects

A new approach to measuring eco-efficiency in generalized IO models with application to the Polish economy in transition

Topic: Classical IO applications: Multiplier and Linkage Analysis
Author: Łukasz Lach
Co-Authors: Henryk Gurgul

Performance assessment in the presence of undesirable outputs, such as pollutant emissions, is usually modelled within the framework of data envelopment analysis (DEA). In recent years the issue of seeking ways to increase eco-efficiency, understood as a management philosophy that aims at minimizing ecological damage while maximizing efficiency of the firm's production processes, has become one of the considerable topics of interest for both researchers and politicians. In this paper we propose a new approach to measuring eco-efficiency in generalized input-output (gIO) models which may be used as a supplementary method to traditional DEA. Unlike DEA this approach takes into account detailed data on intersectoral flows in supply- and demand-driven gIO models. The approach proposed in this paper builds upon a theory of intersectoral linkages and thus it looks at economic processes from a different perspective than the DEA-based models. We focus on cases of traditional and sector-size-adjusted measures of interindustry linkages in gIO models and in each case we suggest respective indices of eco-efficiency and prove their usefulness in policymaking. In order to illustrate possible applications of the new approach we conduct an empirical analysis aimed at identifying the eco-efficient sectors based on the 1995 and 2009 national input-output tables and environmental accounts for Poland which are provided by the WIOD database.

Keywords: generalized input-output models, intersecroral linkages, eco-efficiency, nonlinear optimization.

Developing an energy satellite for an MRIO virtual laboratory

Topic: Multi Regional Input-Output (MRIO) Models Using Industrial Ecology Virtual Laboratory: Development of Regional IE Lab models and Applications
Author: Ka Leung Lam
Co-Authors: Peter Leonard Daniels

National multi-regional input-output (MRIO) virtual laboratories have become increasingly available. They provide a platform for flexible, collaborative and highly-automated compilation of MRIO databases. These virtual laboratories draw on national input-output tables and other sub-national sectoral finance and physical data to compile MRIO tables. They also provide the capacity to compile associated environmental satellites. In general, financial data are often available in better sectoral and spatial resolutions than environmental data. Therefore, in the case of using a more detailed MRIO table for an environmentally-extended MRIO analysis, its quality can be compromised by the disaggregation process of the environmental data to match the corresponding spatial and sectoral details of MRIO tables. This work uses the development of an energy satellite as an example to explore and address this challenge.

This paper describes work aimed at developing more sectorally and spatially disaggregated energy satellites for environmentally-extended MRIO analysis. The specific research question is: how to best sectorally and spatially disaggregate a national energy account for sub-national MRIO applications. For the method used, this work utilises energy-related proxies for disaggregation and implements the energy satellite in the Australian Industrial Ecology Virtual Laboratory

(Australian IELab). Data used include i) energy data from the Australian Energy Account, and the Australian Energy Statistics, ii) energy expenditure data from the Australian national input-output tables, and iii) CO2 emissions data from the Australian Greenhouse Emissions Information System. The major novelty of the research is the use of energy-related proxies for sectorally and spatially disaggregating national energy account for MRIO applications in a virtual laboratory environment. The paper considers some of the potential analytic and policy applications of MRIO data and research focused on sub-national energy data.

Using supply and use tables to study the energy sector: a simulation of the self-consumption in Spain

Topic: IO Data for environmental and social analyses
Author: Raquel Langarita
Co-Authors: Julio Sánchez Chóliz

The redesign of the electricity market is an absolute necessity today, since the transformation to a decarbonized system is needed in order to maintain the environment, which implies the use of renewables, for which several actions and efforts are needed.
Within the countries of the EU, despite its great potential in green technologies, Spain has a high energy dependence and its electricity system is characterized by a low competition and other managerial problems. One of these critical issues is the challenge of the implementation of the self-consumption, which will be the issue analysed here. Thus, the aim of this this paper is to analyse the economic and environmental effects of the implementation of the electricity self-consumption in Spain.
Self-consumption might reduce the electricity losses due to transmission and distribution. Secondly, it is a clear advance in the aim of a sustainable and decarbonized economy. And, finally, according to Langarita et al. (2017), the implementation of the self-consumption could reduce electricity costs in an irrigation scheme, such as one in the Northeast of Spain. Now, we would like to know how this measure could affect the rest of the variables and industries of the whole Spanish economy from a multisectoral perspective, not only irrigated agriculture in a concrete area.
As is known in the literature, the input-output model is a good tool to study energy and electricity sectors. Inside the input-output framework, we propose in this paper to use supply and use tables, since electricity is a product and we can observe its production in the supply table. In this sense, we use the supply and use tables for Spain for 2015, published by the National Institute of Statistics (INE in its Spanish acronym) and we modify the coefficients of the different sectors to include the scenario of self-consumption.
As a first step to advance in the modelling of the electricity self-consumption, with the original supply and use tables, following the methodology of EUROSTAT (2008), we obtain the symmetric table. Then, after having simulated the self-consumption in the supply and use tables, we obtain the symmetric one again. We use input-output applications to see the differences between the symmetric table before and after the self-consumption implementation. Making use of an emissions vector, we can fast observe the effects on CO2 emissions. We can also see the structural change in the Spanish economy associated with these simulations. Additionally, how the household income changes, the trade, and other economic variables. To this end, we will mainly use dependence chains and structural decomposition analysis (SDA).
Following Duarte et al. (2017), a next step in this analysis is the self-consumption simulation disaggregating electricity into several subsectors in supply and use tables.

Foreign multinationals in services sectors: A general equilibrium analysis of Brexit

Topic: Modelling the effects of Brexit II
Author: Maria C. Latorre
Co-Authors: Zoryana Olekseyuk, Hidemichi Yonezawa

Research question: We provide an in-depth analysis of the role of services Multinational Enterprises (MNEs) in international trade and their impact on the economy, with an application to Brexit.

Method used: First, we deliver the latest data on the so-called "servicification" of economies, especially focusing on trade (e.g., Borchert, 2016; Miroudot, 2017). Then, we provide a literature review focusing on the difference between the impact of services MNEs and the ones in manufacturing. Finally, we illustrate the importance of services MNEs for the UK in a general equilibrium simulation analysis of Brexit.

The data used: Our analysis is mainly based on GTAP 9 Database (Aguiar et al., 2016). The model includes 11 regions, 21 sectors and four types of production factors. Potential tariff rates between the EU-27 and UK are calculated using the external applied MFN tariffs of the EU from TRAINS for 2015 as well as trade flows for 2014. Non-tariff barriers to trade are taken from Dhingra el al. (2017) and to FDI in services from Jafari and Tarr (2017).

Novelty of the research: We apply an innovative computable general equilibrium (CGE) model, which combines the state-of-the-art trade theory with firm heterogeneity à la Melitz with foreign MNEs in services. We pay particular attention to how Brexit affects the performance of European and British MNEs and how this contributes to the overall losses of the UK economy. We find that the increased FDI barriers in services sectors explain about one third of the total welfare loss of Brexit. Furthermore, our decomposition analysis (by introducing each type of barriers separately) shows that the barriers against EU services multinationals in UK are harmful to British manufacturing sectors because they face a reduced (and more expensive) supply of intermediates of services.

Extending the input-output framework to calculate household energy service demands: a UK case study

Topic: IO's role in covering environmental policy needs
Author: Joseph Lawley
Co-Authors: John Barrett, Anne OWEN

There is a need to reduce global energy use in order to reduce the impacts of anthropogenic climate change, yet global energy demand continues to rise. Traditionally, improving the efficiency of the systems that deliver energy to consumers is the core strategy undertaken to reduce energy demand, however this framing does not account for the fact that household-level energy services, rather than energy itself, are demanded by consumers and are therefore the main drivers behind energy consumption. Framing analyses of energy consumption by considering the energy services desired by households, such as transport, is becoming an increasing predominant analysis tool. Examining energy use in this way provides useful insights into consumption patterns, thus allowing opportunities to reduce energy demand beyond energy efficiency improvements to be identified. The demand-side of the energy system is poorly

modelled however, while previous work examining energy system emissions neglects the potential demand-side emission reductions offered by changes to energy service provision due to the technological focus of many energy models. This paper addresses these issues through an energy-extended multiregional input-output analysis of the UK's household-level energy service demands over a twenty-year period from 1997-2016. Using this method, household demand is extended to energy services using UN COICOP data, while the input-output analysis provides an insight into the energy footprint of UK household-level energy service demands, their evolution over the examined time period and their contribution towards UK emission levels. By undertaking an analysis of energy demand in this unique way it has been possible to examine energy service consumption patterns within the UK and outline areas where opportunities for energy demand reduction through changes to service level and service provision exist.

Induced subnational government expenditures in an Input-Output framework: a first assessment

Topic: Classical IO applications: Multiplier and Linkage Analysis
Author: Fabrício Pitombo Leite

The rationale for a differential treatment of state and local government spending vis-a-vis the central government spending can be found in Levinson (1998) and Clemens and Miran (2012). In a nutshell, as the subnational entities are subjected to balanced budget requirements, the pro-cyclicality of expenditures emerges as a consequence, which justify our strategy of endogenizing subnational government expenditures from the innovative standpoint of an input-output framework. On a theoretical level, all the subnational government expenditure could be considered induced by the aggregate national income, leaving the federal government spending aside as autonomous. An augmented multiplier / supermultiplier process can be described in algebraic terms and can be computed where appropriate data is available. This paper proposes a first assessment of this induction mechanism and its consequences through multisectoral modeling but rendering macroeconomic consequences. Estimates are presented using Input-Output data from the World Input-Output Database (WIOD) and Subnational Governemnt Spending data from OECD. The multisectoral representation of Keynesian multipliers, with endogenous consumption expenditures, has a clear connection with input-output multipliers. From this representation we depart towards the development of Sraffian supermultipliers (Serrano, 1995; Freitas and Serrano, 2015) by endogenizing investment expenditures, and, further, to the endogenization of subnational government expenditures. From a Sraffian macro-oriented perspective, we can find some recent tentative multisectoral representations in Dejuán (2014), Portella-Carbó (2016), Portella-Carbó and Dejuán (2018) and Leite (2018).

From input-output to macro-econometric model

Topic: Input-output and sectoral macro-econometric modelling: Part of the same family
Author: Richard Lewney
Co-Authors: Jean-Francois A Mercure, Hector B. POLLITT

Organised session 2019 - Input-output and sectoral macro-econometric modelling: Part of the same family

Title: From input-output to macro-econometric model

Abstract

(1) Research question
This paper shows how it is possible to build a macro-econometric model, starting from a standard input-output framework.

(2) Method used
We first describe the data that are required. We then define an econometric specification to determine behavioural relationships within the model, for example price-demand elasticities.
The paper provides a detailed description of how these different elements may be combined to create a set of simultaneous equations that build on the structure of the national accounting system to create a dynamic, empirical macroeconomic model. The treatment of prices and the difference between real and nominal variables in the model is discussed. Extensions to the basic accounting system, for example to include the labour market and demands for energy and materials will be included.

(3) Data used
Input-output tables and time series macroeconomic and sector/product data for final expenditure, prices, output, value added and jobs from statistical offices.

(4) Novelty of the research
The final discussion in the paper relates the model to wider economic theory and current policy challenges. We show that the model may be quite different from neoclassical or New Keynesian macroeconomic theory but, depending on the specification of the equations, can be broadly consistent with post-Keynesian theory. We conclude with a comparison of some of the differences in properties between a basic input-output-based multiplier analysis and the model that we have just constructed.

Modelling the impact of Brexit using the E3ME macro-sectoral model

Topic: Modelling the effects of Brexit I
Author: Richard Lewney

(1) Research question
This paper estimates the economic impact of Brexit on the UK under a number of different types of exit.
(2) Method used
A series of scenarios is constructed to reflect alternative possible trading relationships with Europe, ranging from a 'Norway' scenario where the UK remains in the European Economic Area (EEA), to a 'No Deal' scenario, where the UK-EU trading relationship reverts to WTO rules. The modelling focuses on the impacts on trade, investment, migration/the labour market and prices, drawing implications for regions and poor households. The analysis applies E3ME, a global macroeconomic model that captures bilateral trade relationships between the UK, each EU Member State and key global trading partners. E3ME includes a series of econometric equations to estimate the behaviour of firms and households in response to economic drivers and applies an input-output framework to model industry interdependencies.
(3) Data used
Input-output tables and time series macroeconomic and sector/product data for final expenditure,

prices, output, value added and jobs from statistical offices. Assumptions drawn from the literature, notably for the tariff-equivalence of non-tariff barriers by product and the impact that migration has had on unemployment and wages.
(4) Novelty of the research
The analysis goes beyond purely macroeconomic results, examining the implications for sectors, regions and poor households.

Visualizing spatial effects of regional emissions in China: A combination of multi-regional input-output analysis and complex network analysis

Topic: Thematic IO analysis: Energy and Environment
Author: Jing LI

This paper proposes an environmental extended multi-regional input-output model (EEMRIO) together with the complex network analysis to uncover the regional CO_2 emission structure at national, regional, and sectoral level, and then the spatial decomposition analysis is used to evaluate the determinants of emission flows. In contrast with studies investigating the CO_2 emission structure based on traditional EEMRIO, network analysis and central degree analysis are important tools to show the correlation and relationship between regions and sectors. Following EMRIO tables, we calculate the complete CO_2 emission matrix representing by a n * n matrix to show a network with regard to regional CO_2 emissions. By using the elements of the network, we can define self effect and sectoral spillover effects. Self effect are the elements on the main diagonal including the feedback effects, while spillover effects are the non-diagonal elements of matrix. Complex network analysis is used to analyze the production-related emission network at the national, regional, and sectoral levels, in which regional industries of the MRIOTs are treated as nodes and the values of the emission matrix are treated as links. In the network analysis based on EMRIOTs, regional and sectoral heterogeneous are considered. Spatial structural decomposition analysis is used to illustrate the determinant of regional emission flows and emission structural changes. In this paper, Chinese multi-regional input-output tables for 2007,2010, and 2012 are used. We observe that at national level, small clusters have been found, implying the regional in the same cluster are highly connected through regional emission flow, while at regional level, electric power generation and heavy industries play the role on emission transfer. For the spatial structural decomposition, changes in final demand scale will have positive spatial effects for most region, while final demand structure, such as consumption and export, may reduce emission in other regional. Investment in one region, may have different spatial effects. Based on the analysis of spatial effects, overall planning for industrial transfers and environmental protection throughout the entire country, cooperative development within adjacent provinces will remarkably promote emission mitigation. Meanwhile, to keep the promise of reducing CO_2 emissions, increase energy efficiency will be the effective way for China.

Towards meaningful consumption-based planetary boundary indicators: The phosphorus exceedance footprint

Topic: Planetary Boundaries and IOA
Author: Mo Li
Co-Authors: Thomas O. WIEDMANN

Abstract

The idea of measuring humanity's footprint against planetary boundaries has attracted wide academic attention but methods to implement the theory in sustainability accounting remain underexplored. To help nations take collective actions to stay within a safe operating space, footprinting approaches need to be revised to accommodate biophysical limits. Here we develop a novel sustainability indicator, the phosphorus exceedance footprint (PEF) that measures countries' contributions to the transgression of the planetary boundaries for phosphorus. Adopting a consumption-based perspective reveals how nations contribute to environmentally unsustainable phosphorus pollution in their trading partners. This captures country-specific transgression through supply chains in a way that complements conventional footprinting. In 2011, 27% of the world's PEF was associated with international trade flows. Wealthier countries tend to reduce their domestic phosphorus fertiliser exceedance, thus preserving their own natural environment, while increasing their share of imported P-embodied products through trade. A pattern of highly uneven distribution of phosphorus-compromised economies is revealed, with 76% of the worldwide exceeded phosphorus embodied in exports supplied by only four countries: China (42%), Brazil (19%), India (10%) and New Zealand (5%). All countries transgress phosphorus planetary boundaries, even those that do not exceed their own territorial boundaries. Our findings highlight that mitigation strategies need to include international cooperation on increasing the efficiency of fertiliser use and reducing the demand of products that cause phosphorus exceedance.

Key words: planetary boundary transgression; exceedance footprint; global multi-region input-output analysis; phosphorus; globalisation; trade

RQ: How global P boundaries are exceeded by consumption at local levels?

Method: Consumption-based accounting

Data used: GTAP-MRIO + FAO data + PB theory

Novelty: To our knowledge this is the first attempt to apply the exceedance footprint concept using downscaled national planetary boundaries as a benchmark, providing a global assessment of how these boundaries are exceeded by consumption elsewhere. Our paper opens up a potentially new field of 'Exceedance footprint'.

This is the first empirical paper that combines absolute sustainability, local PB boundaries and footprint into one paper.

What Makes It Important? The Role of Real Estate Sector in Economy and Its Determinants

Topic: Classical IO applications: Industrial economics, Productivity and Efficiency
Author: Xiuting Li
Co-Authors: Jichang Dong, Jing HE, Shuqin Liu, Fan Liu

Scientifically understanding the role of the real estate sectorin national economy facilitates reasonable and effective regulation and economic development. Using panel data from a sample of 39 countries through 2000 and 2014, we investigate the role of real estate sector in different countries and its determinants. The empirical study produces three findings. First, real estate sector has strong linkage with financial service sector, construction and wholesale & retail trade. Specifically, China's real estate sector has higher direct consumption of financial service activities compared to other countries. Second, the input and output of real estatesector shows a transition trend from primary and secondary industries to service-oriented industries. Third, the key determinants of the economic effects of the real estate sector in a country include the economic growth and the current national income level, the financial development, as well as the urbanization level of the country. The 2008 financial crisis has significant impacts on the determinants of the role of the real estate sector. The results indicate that the quality of urbanization matters more than its speed. The contributions of this study lie in three aspects. First, we provide new evidence on the push and pull effects of real estate sector and itschange of input and output structure. Second, this study empiricallydemonstrates the determinants of development through a method-of-moments (GMM) approach. Thirdly, we use a panel dataset with annual data of 39 countries (regions) from 2000 to 2014, which ensures the robustness of conclusions.

Application of supply and use tables: centralized deflator compilation system Voltti for production indices

Topic: Better to deflate SUTs but … how to do it well?
Author: Ville Lindroos

A new centralized deflator and volume calculation system, Voltti, has been introduced in Statistics Finland. It utilizes the supply and use table framework in order to improve the coherence of price and volume calculations between National Accounts and Production Indices.
Deflator coherence is being achieved by using supply and use tables as weights on the deflator compilation, as well as taking all calculation definitions such as product level price sources, and methodological decisions from the compilation of fixed priced supply and use tables. These decisions include for example price index formulae for the deflators, deflation of taxes and margins, and correct deflation and aggregation order.
The advantages for production indices gained with the system are such faster production, higher quality of deflators, coherence with national accounts, and a smoother workload distribution with the more automated calculation system and co-operation with other departments.
This cross-departmental system is accessed via a web-based software. The software interface itself is mostly used for managing all the metadata related to the calculations, most challenging of those being the price-product links. For the actual execution of deflation compilation, the call can be done either via the volume index side of the software, or via web browser url. Other statistical software such as SAS can be used to call the url to acquire a large set of deflators as a part of a production process.

Evaluating the Impacts of Waste Treatment Management Modes on Each Sector's Price in a Macro Economic System

Topic: Thematic IO analysis: Environment
Author: Xiuli LIU
Co-Authors: Geoffrey J.D. HEWINGS

This paper created an Input-Occupancy-Output (IOO) table that was integrated with several alternative waste treatment management modes. Based on this table, a Ghosh price model was developed to evaluate the price changes in each sector compared with their traditional prices for the direct and indirect impacts of the costs of waste treatment management modes. The model was applied to the waste water treatment case in China. The data were sourced from the China Statistical Bureau and a survey made by Tan et al. (2015). In each waste treatment management mode, the price change of each sector was evaluated. The results revealed that different waste treatment management modes generated different ranks for the price changes by sector. The total price increase for all industries (TPI) in the centralized treatment mode (CTM) is 32.7% smaller than that in decentralized treatment mode (DTM). An optimal combination of DTM and CTM for all industries was found that has a 90.2% and 85.5% decrease of TPI than that of DTM and CTM respectively. Among the 42 industries, 22 industries recorded an OI >50%, which revealed that the indirect impacts from all the other sectors on their prices were larger than those generated by the sector itself. To limit the waste water discharged in China, one possible intervention would be to increase the fine imposed for unit waste water discharged, setting it at a higher level than the unit waste water discharge fee and its treatment cost. Furthermore, it is suggested that the waste water treatment cost needs to be reasonably incorporated in the products' prices. The model proposed in this paper will be particularly appropriate to evaluate these price increases and their impacts, which is also the innovation of this paper.

Identification of key sectors in greenhouse gas emissions for the Salvadoran economy: an application of the input-output analysis

Topic: Classical IO applications: Multiplier and Linkage Analysis
Author: Meraris Carolina Lopez

This article explores the key sectors of the Salvadoran economy in terms of direct and indirect emissions of greenhouse gases for the years 2005 and 2014.
The key sectors with backward linkages (driven by demand) over the multipliers will be obtained following the Rasmussen / Hirschman methodology (presented in Alcántara, 2007, Piaggio, Alcántara, & Padilla, 2014). To avoid biases towards small sectors and their contribution to total emissions, we consider the weighted multipliers and not weighted by the final demand.
The data to be used comes from the supply and use tables of El Salvador 2005 and 2014 and their corresponding transformation to input-output tables through the Eurostat methodology (model B), as well as the emission data contemplated in the Second and Third Communications National on Climate Change of El Salvador (MARN, 2013 and 2018), complemented with the Eora database (Eora: Kanemoto, Moran, & Hertwich, 2016).
This study is novel and important, because it is the first time in the country that the input-output analysis framework is used to determine the sectors that are generating the greatest amount of emissions in their production processes, either to satisfy their own demand (direct emissions) or demand from other sectors of which they are suppliers (indirect).
It also states that, although El Salvador is not a country whose emissions are significant on a global scale, the differentiation between direct and indirect emissions becomes relevant in the

framework of the design of public policies, since it allows identifying which are the most appropriate policies for the direct issuers (options focused on the last link in the production chain) and what could be the most appropriate policies for those sectors that pollute indirectly (policies based on intermediate and final demand).

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Options for Water Distribution and Wastewater Treatment in Mexico City

Topic: Addressing Strategic Challenges of the 21st Century: Deepening the Collaboration between Input-Output Economists and Industrial Ecologists
Author: Carlos Andres Lopez-Morales

Session Title: Addressing Strategic Challenges of the 21 st Century: Deepening the Collaboration between Input-Output Economists and Industrial Ecologists
Session Organizer: Faye Duchin

Options for Water Distribution and Wastewater Treatment in Mexico City

Carlos A. López Morales
Professor
El Colegio de México
Centro de Estudios Demográficos, Urbanos y Ambientales
Mexico City, Mexico

While the centrality of water in the ecological sustainability of socio-economic systems gains in recognition and acceptance, recent research in input-output economics has made progress in exploring the complex relationships between hydrologic and economic variables. Given particular developments in economic modeling and in the provision of data, the interdependencies between volume requirements, production technologies, and the conditions for environmental sustainability, even distinguishing among water sources, are now possible to establish and compute at the regional, national, or global levels.

Input-output databases typically combine activities for water distribution and wastewater management into a single sub-sector, frequently further merged into a "utilities" sector, along with the provision of gas and electricity. To further evaluate goals of development and sustainability in the present and in the future, the representation of water extraction, distribution, and wastewater management needs to distinguish specific and alternative ways of providing these services. A review of the literature shows that industrial ecologists have developed the data needed to implement LCAs about, for example, alternative wastewater treatment activities. However, these analyses are typically conducted for individual processes rather than extending the boundary to include all the processes required from the intake of needed resources to the delivery of the service in question.

Thus engineering information is available for specific parts of the production processes for providing water-related services, and a framework exists for incorporating such information for analysis within the context of the economy as a whole. This paper addresses the vital "middle" levels of information and of conceptualization that are still missing: namely, identifying the relevant stages of production and distribution and organizing them into identifiable economic sectors for analysis of alternative ways of providing basic water-related services in environmentally sustainable ways. Mexico City faces a severe water crisis and serves as the case study for developing these concepts and technological options.

Evaluating uncertainties in WIOD data base

Topic: Methodological aspects of input-output analysis
Author: Oleg LUGOVOY
Co-Authors: Andrey POLBIN, Vladimir POTASHNIKOV

The process of compiling and updating Input-Output tables involves uncertainties, stemming from the lack of data, updating or balancing technique. Application of alternative methods and subjective decisions will lead to different IOT estimates, meaning that the resulting tables have an embedded uncertainty. Though this uncertainty across methods is hard to measure and, more importantly, evaluate its significance on the stage of IOT application. In this paper, we discuss a way to evaluate an uncertainty of methodological choose with an application to the WIOD and discuss the results. The study includes several steps. First, we update WIOD database on historical data with several mainstream techniques, including RAS, cross-entropy, and maximum likelihood with alternative specifications of the likelihood function (based on normal- and beta-distributions). Second, we use the resulting differences in the updated with different methodologies tables as a measure of the uncertainty from the updating technique. The estimate can also be combined with a historical data to take into account ongoing structural changes of input-output coefficients, or with other data including experts' opinion regarding expectations of further structural change of the economy. Third, we apply Monte Carlo Markov Chain methodology to simulate IOTs around a benchmark table using the estimated variance as prior information for input-output coefficients distribution. The Bayesian technique with MCMC has been discussed on previous IIOA conferences as an IOT updating tool. Instead of point estimates, the methodology allows simulating a set of matrices consistent with the data. The simulated joint posterior distributions of input-output coefficients are used to identify cells of the matrices with the most substantial variability, indicating sensitivity to the choice of the updating technique. The resulting distribution-based estimates have minimal shares of outliers and can be considered as more robust compared to the mainstream point estimates updating techniques.

Full probability density model for IOT and national accounts

Topic: IO Theory: Advances in input-output theory
Author: Oleg LUGOVOY

The paper discusses a theoretical framework for deriving marginal probability density functions for input-output coefficients (IOC) and the joint probability model for input-output tables. The idea that IOC can be considered as a distribution rather than a point estimate has been discussed by Jackson (1986) where he tried to link the problem of aggregation of micro-data and uncertainties from the survey data with IOT framework. The paper advances this idea by deriving full probability density functional form directly from the input-output model, which is consistent with proposed by Jackson (1986) framework for individual io-coefficients. Modeling the exact probability density provides several benefits over evaluation of uncertainties around a particular state of the matrix, and admittedly over the point estimates. First, the marginal and conditional distribution of io-coefficients is theoretically grounded, i.e. has known functional form, and can be directly used in analyses such as studying of uncertainties in data, Bayesian updating or disaggregation of IOTs, optimization problems, and many other. Second, stochastic sampling techniques (like MCMC) can be avoided or dramatically improved for generation of random matrices. This feature significantly reduces computational barriers of the probabilistic/stochastic analyses of IOTs and extends the application of the proposed methodology for very large matrices. However, even if the marginal PDFs for individual io-coefficients derived from the exponential family of distributions, it is not straightforward to generate a random sample for the full matrix because of the constraints imposed by the input-output model. Therefore, we consider several techniques to generate random matrices, which satisfy all the constraints on the io-coefficients. The techniques with the best results allow sample very large matrices (10 thousand rows and columns) within minutes, and will be presented at the conference for a discussion. Finally, the proposed probabilistic framework can be adopted for other national accounts, as well as for probabilistic macroeconomic modeling.

How to catch the rebound effect in interindustry modelling

Topic: Modelling energy use and production in interindustry models
Author: Christian Lutz

Increases in energy efficiency are reduced by the rebound effect. Efficiency gains on the micro level do not lead to proportionate reductions of energy consumption on the macro level. Most of the empirical approaches assume an autonomous increase of energy efficiency and analyze rebound effects on macro and sector level. Any cost and investment needed to reach additional energy efficiency in already highly efficient market economies are often neglected. In the applied CGE models the economy and its sectors adjust smoothly to the positive efficiency "shock" via reduced costs and prices in the more efficient industries, as substitution between factor inputs is possible in no time according to substitution elasticities. Sometimes lower short-term and significantly higher long-term substitution elasticities are used to calculate the respective effects. Rigidities due to long-life cycles of energy intensive capital stocks are thus accounted for quite generically. There is some understanding about how the rebound effect on the sector and macro level will change with assumptions about the central parameters in sensitivity analyses. Policies and their additional effects on top of energy efficiency are only rarely considered in these approaches.
The German energy-economy INFORUM-type model PANTA RHEI, including a time series of national IO tables, will be applied to better understand the rebound effect in this type of model by

a set of simulations. Starting from an autonomous increase in energy efficiency in some industries, the analysis will be broadened towards necessary investment for energy efficiency improvement and the role of technical progress for the effects. The impact of different model characteristics and scenario assumptions will be shown.

Macroeconomic effects of energy transition

Topic: Thematic IO analysis: Energy and Environment
Author: Christian Lutz
Co-Authors: Markus Flaute, Ulrike Lehr

In order to determine the macroeconomic impacts of the energy transition in Germany in the past and future, two model-based scenarios are compared. The Energy Transition Scenario (ETS) represents a world in which the energy transition since the year 2000 developed as it actually took place and in which the targets of the energy transition will be achieved in the future. The Counterfactual Scenario (CFS) represents a consistent alternative development that can be described as follows: Since the year 2000, no support for renewable energy and energy efficiency took place and will not take place in the future. Only those technologies will be used for energy transformation that are market-driven.

The ETS and CFS scenarios are implemented into the macroeconomic model PANTA RHEI, combining a time series of national IO tables with national accounts and energy balances. The comparison of the macroeconomic results in the two scenarios shows consistently positive effects of the energy transition. Results have been calculated until the end of 2018 in a project for the German Ministry of Economic Affairs and Energy. The results are in the same order of magnitude and point in the same direction as our own previous studies and other related studies, both at the national and international level. In contrast to previous studies, the energy transition starts already in 2000 and ex-post results have been calculated. Also recent deleopments such as the excellent macroeconomic situation, which could foster crowding out of investment in the energy transition are accounted for. Sensitivity analyses with restrictions on the labour market and on the financing of additional investments show that these aspects should also be observed more closely in the future.

Analysing Price Competitiveness in the European Single Market: A Decomposition of Inflation Differentials based on Leontief Input-Output Price models

Topic: IO Theory: Input-Output Price Model
Author: Bernhard Mahlberg
Co-Authors: Andreas Eder, Wolfgang Koller

In this paper we introduce a price analysis approach based on Leontief input output price models and structural decomposition analysis (SDA). A comprehensive decomposition procedure enables us to reveal the drivers of producer price inflation. We apply the suggested model to analyse producer price inflation differentials of a representative sample of member states of the European Union against the background of the implementation of the Single Market Program in the second half of the 1990ies and the introduction of the single European currency beginning in 2002. The sample period extends from 2000 to 2014. The data basis consists of a time series of World Input Output tables enlarged by detailed Social Economic Accounts taken from the World Input Output Database and Eurostat.

Our approach allows not only to describe the development of inflation differentials in the sample of countries before ("pre-2008 period") and during the economic and financial crises ("post-2008 period") but to identify the contributions of the underlying drivers. While not immediately revealing causal relationships the SDA based approach produces a decomposition that is "true" in the sense of an accounting relationship. Thus, we can evaluate to what extent the differences of sectoral producer price inflation vis-à-vis Germany is due to different developments of prices of imported intermediate inputs, productivity of imported intermediate inputs, prices of domestic intermediate inputs, productivity of domestic intermediate inputs, labour price, labour productivity, unit net operating surplus, unit consumption of fixed capital, and unit tax less subsidies. The development of prices of domestic intermediate inputs are explained by the various price and productivity (or cost) developments in the upstream sectors In this way our approach accounts for the indirect effects originating from the interdependences of sectors in an economy.

The main novelty of our approach is that it is based on the Leontief input-output model (Leontief, 1951) and uses a decomposition approach developped by Fujikawa et al. (1995) and Fujikawa and Milana (2002). Structural decomposition analysis has been often used to decompose economic growth (or growth in employment, trade, emissions, energy consumption) between two or more years into components attributed to factors such as productivity changes, structural changes and final demand changes. The application of this method to the decomposition of producer prices is seldom done but straightforward. Marrying decomposition analysis with input-output analysis allows to not only quantify the direct effects of changes in prices and productivity of factors of production but also their indirect effects conveyed via intermediate input effects.

Within the framework of the Leontief price model the prices and technical input needs (thus, the productivity) of primary factors, and the changes thereof, are taken as exogenous and the prices of gross output, and the changes thereof, are determined endogenously. Thus, this approach necessarily takes on a cost-push view at explaining of inflation. Nevertheless, based on the framework of national account data, this corresponds to revealing an accounting relationship. The main drivers of changes of producer prices are identified.

Structural analysis of Bio-economy sectors in the European Union: the BioSAMs

Topic: IO modeling: Computable General Equilibrium Modeling and Social Accounting Matrices
Author: Alfredo J. MAINAR CAUSAPÉ
Co-Authors: George Philippidis, Ana Isabel Sanjuán López

Bio-economy includes the production of renewable biological resources and the transformation of these resources and waste streams into value-added products, such as food, feed, biological products and bioenergy. In this way, the bio-economy groups different sectors of the economy: agriculture, forestry, fishing, food, chemical products and bio-based materials and bioenergy, and also encompasses academic disciplines and political areas. Therefore, it is of great interest to analyse the structure and characteristics of these sectors. To carry out this analysis, one of the great obstacles is the lack of information and complete databases that allow the analysis of the bio-economy and its effects on the overall economic activity. To overcome this issue, a set of Social Accounting Matrices has been obtained for highly disaggregated bio-based sectors for the 28 European Union member states (and an aggregate for EU28) for 2010, called BioSAMs. This

communication shows the estimation process of these matrices, and also includes an illustrative key sector analysis based on three different and complementary methods (Rasmussen-Jones, Hypothetical Extraction Method and Eigenvector method) to show the potential of this database and the significance of bio-based sectors. Finally, the current work to updating the BioSAMs is presented.

Carbon accounting for households – a case study of a community's emissions

Topic: IO modeling: Consumption-based accounting
Author: Arunima MALIK
Co-Authors: Manfred LENZEN, Joe Lane, Ka Leung Lam, Arne GESCHKE

The aim of this study is to undertake a comprehensive consumption-based supply-chain assessment of a community's emissions, based on their expenditure data. To this end, we use a comprehensive virtual laboratory platform for constructing a customised MRIO database, specific to the case study of interest, using a wide-array of statistical data sources, including the Household Expenditure Survey. We then use the detailed sub-national regional MRIO table of Australia for assessing the consumption patterns of households in a local council area to undertake a supply chain carbon footprint assessment of the community's emissions.

We compare the per-capita CO2e footprints of the Council region with other Australian states, and note that regions with comparatively small populations – such the Inner West Council, the Northern Territory, or the Australian Capital Territory – fluctuate more than those for larger regions or the nation. Furthermore, we undertake production layer decomposition (PLD) by emitting-industries and purchased-communities. We find that emissions from agriculture and mining only become important at layer 3 and above in the emitting-industry breakdown, and that they are not represented in the purchased-commodity breakdown. This is because households do not buy a significant amount of food directly off farms, and nothing off mines. However, in a supply-chain sense, agriculture and mining sit behind virtually every product. Therefore, we find that these two sectors have very different importance in the two PLD breakdowns. Second, and vice versa, business, personal and public services do not appear to be significant in the emitting-industry breakdown, but in the purchased-commodity breakdown, where they become significant only at layer 5 and beyond. This is because, whilst, households buy a significant amount of services, these are not emissions-intensive. We reveal many such relationships in this study.

The EU Regions Integration in Global Value Chains

Topic: Classical IO applications: Trade and GVCs
Author: Giovanni MANDRAS
Co-Authors: Patrizio Lecca

This paper computes the existing gap between bilateral trade in value added (VA) and gross value terms. We derive the distribution of VA trade by regions and countries involved in the global production chain for 10 composite economic sectors using a newly available global input-output (IO) table covering 61 countries, with the 28 EU Member States disaggregated into 267 NUTS 2 regions for year 2013 (Thissen et al. 2019) where bilateral trade in intermediate and final demand goods are fully disaggregated. This is a distinctive characteristic of this dataset in

comparison to others works (e.g., Johnson and Noguera, 2012) where trade in intermediate and final demand goods are not directly incorporated in the global input-output table.

Likewise previous works based on national IO tables (Johnson and Noguera, 2012; Foster-McGregor and Stehrer, 2013; Johnson, 2014; Koopman et al., 2014; Los et al., 2014) we find that the ratio of VA to gross export (vax ratio) differs substantially across countries/regions and sectors. Our main result is that production sharing relationships are more marked in core rather than peripheral EU regions. Moreover, similarly to Johnson and Noguera (2012) we document lower vax ratios in manufacturing sectors in contrast to higher vax ratios found in primary and service sectors. Besides, a homogenous geographical pattern characterizes the manufacturing sectors while geographical disparities are more noticeable under primary and service sectors.

AN ANALYSIS OF FINANCIAL INTERMEDIATION IN SOUTH AFRICA: EVIDENCE FROM THE SUPPLY AND USE TABLES

AUTHOR: RUSHIL MANGA
Master of Commerce in Economics Candidate
Nelson Mandela University
South Africa
rushilmanga@gmail.com

CO-AUTHOR: KAMBALE KAVESE
Senior Economist
ECSECC
South Africa
kambale@ecsecc.org

ABSTRACT
South Africa's post-recession economy has persistently been characterised by a dual threat of a low growth path and rising inequality. This could suggest that government's priorities-based investment policy is not geared towards sectors that yield the optimal macroeconomic outcome. Given China's pledge to invest US$14.7 billion in South Africa, this study uses a Dynamic SUT Leontief Multiplier Based Model to assess the impact of such investments on macroeconomic variables and, specifically on the financial intermediation sector, that plays a significant role in economic development and growth. Financial intermediation in South Africa has been pressurised by the global financial crisis, and has since further displayed events of bank failure. Data was collected from Statistics South Africa's Supply and Use Tables for the years 2005, 2010, 2014, 2015, and 2016, with the aim to display trend analyses of prior and post-recession, as well as changes in selected Type I and Type II Leontief multipliers. The most striking overall observation from the empirical results is the stagnation in gross value-added (GVA) and other multipliers over the 2010-2016 period. This implies that during the post-recession era, the effect of the average

One Rand invested in the economy, although positive, yielded a smaller return in terms of economic growth. Empirical investment scenarios are provided, and the study recommends the scenario under which China's investment will optimally impact South Africa's economic growth, especially in the financial intermediation sector.

To be presented as a working paper at the 27th International Input-Output Association Conference, and
9th Edition of the International School of I-O Analysis
30 June to 5 July 2019, Glasgow, Scotland

Key words: SUT, financial intermediation, impact appraisal, South Africa and China.

Hospital Activities and Cost Matrices and their Models

Topic: Enterprise-related input-output analysis
Author: Casiano A. Manrique de Lara Peñate
Co-Authors: Luis Márquez Llabres, Pablo Alberto Maciuniak

Enterprise input-output has been the subject of IO research for many years now. We propose to use this structure in the modelling of health services at public hospitals. The activity at hospitals generates enormous amounts of information of all types. Putting this information together in a way that facilitates the preparation of simulation models is the aim of this paper. As far as we know, this effort has not been previously undertaken.

The input-output tables offer a perfect basis to such analysis. Final demand represents all the health services provided by the reference hospital. The users of these services are divided by gender and age. We classify the sanitary services using the categories used in the hospital to identify the type of sanitary service provided. We identify each service provided by the hospital and describe its cost structure. There are four main types of activities, those directly provided to patients, intermediate activities (e.g. clinical analysis), and structural activities (cleaning activities). Each of them provide certain services that are used by both the activities that provide directly services to patients and those, which do not. The different services also incorporate external goods and services and labor.

The resulting Hospital Activity and Cost Matrix (HACM) can serve as basis of the typical demand and price input-output models. We have prepared the HACM of a concrete hospital in Spain, having a budget of around 300 Mill. USD, to show a concrete application. We believe the availability of HACMs would enhance the economic modelling possibilities in the health sector. We believe it can also serve as the basis of different types of efficiency analysis.

Compilation of foreign trade data having regard to the impact of globalisation in Hungarian SUT

Topic: Globalisation and some effects on SUT compilation relevant for users
Author: Forgon Mária
Co-Authors: Eva Varga

The SUT is an integrated part of the National Accounts compilation in Hungary. In the frame of this integrated system special attention is made to the compilation of export and import data having regard to the impact of globalisation. The aim at this paper is to describe the most recent improvement in this field. An integrated approach has been worked out to construct the export and import of goods and services using the data from different and incomplete sources. The main used data sources are the databases of the foreign trade flows of goods at the most detailed level of Combined Nomenclature (CN) and of services by EBOPS nomenclature cross classified with the exporting and importing industries and with the different type of transaction (normal flows, foreign trade reported by non-resident VAT registrations, subcontracting, re-imports, re-exports, merchanting, factoryless production).
The first part of our paper gives an overview on the methodological aspects and the data sources.

The second part of our paper focuses on the solutions of problems raised during the estimation of exports and imports according to the national concept.
This improvement has an important role following the principle of change of economic ownership as required by ESA 2010 in national accounts.

Migration and Employability Indicators: A Structural Analysis

Topic: Thematic IO analysis: Social and Socio-Economic Analysis (on Migration)
Author: Maria Socrates Markaki
Co-Authors: Athena Belegri-Roboli, Panayotis G. Michaelides, Konstantinos N Konstantakis, Theocharis Marinos

After the recent sharp increase of migrants, refugees and asylum seekers (MRAs) arrival in Europe, the issue of migration is forefront in the policy agenda of all European countries. In this context, a crucial issue is to investigate the employability potential of MRAs and their integration process into the labour markets of their host countries. The aim of this research (funded by H2020-SC6-REVINEQUAL-2017) is twofold: first, to propose a methodology for estimating the MRAs' employability for a specific economy and, second, to investigate the results of the methodology for a selected panel of EU countries , namely the Czech Republic, Denmark, Greece, Italy, Finland, Switzerland and the United Kingdom. Two composite indicators are introduced, providing a method for the matching of skills and qualifications of MRAs across the various sectors (the first indicator) and the occupations (the second indicator) of the economy; aiming at the optimization of the integration process. For the construction of the indicators a number of variables are taking into account in order to identify the structural characteristics of the examined labour market at the sectoral (2-digit NACE Rev. 2) and occupational level (2-digit ISCO-08). These variables are: (i) the structure of employment by sectors of economic activity and by occupations; (ii) the growth rate of employment; (iii) the backward and forward employment multipliers; (iv) the occupational multipliers and v) job vacancy rate by sector. Additionally, the similarity of the MRAs' skills (educational attainment level) is estimated in sectoral and occupational level using the Manhattan distance. The data used in the research are: the input-output tables for the examined countries (WIOD), data on the structure of employment

by sector and occupation at the 2-digit level (LFS) and data on job vacancy rate by sector of economic activity (Eurostat). The findings suggest that employability opportunities for MRAs' in most economies are allocated in primary and secondary sector, whereas in terms of occupations these opportunities are allocated to skilled workers and elementary occupations. Nonetheless, it is apparent from the analysis that these labour markets exhibit increased heterogeneity in terms of structure. This in turn implies that tailor-made policy actions should be put forward in order to aid the smooth integration of MRAs' in these economies.

The Social Weighted Impact of University International Conferences on Glasgow

Topic: Murals and miniatures: applying social accounting with a very broad brush, and with fine strokes to precious cameos
Author: Richard James Marsh

Title: The Social Weighted Impact of University International Conferences on Glasgow

Authors: Ursula Kelly, Richard Marsh, Professor Iain McNicoll

Abstract

Universities are known to be important in supporting economic activity in their host cities and regions. Their role in attracting business tourism has however been less studied. This paper uses an extended Input-Output framework to provides empirical estimates of the impacts on both the city and Scottish economy arising from international conference activities in Glasgow that are associated with the three City Universities (University of Glasgow, Glasgow Caledonian University and the University of Strathclyde).

An integrated applied Input-Output and gravity modelling framework is used to provide GDP and employment impact estimates for Scotland, the city of Glasgow and for communities across Glasgow based on Scottish Parliament constituencies. The study uses visitor data collected from the universities and the Glasgow Convention Bureau for the financial year 2016-17.

An additional innovation is the analysis of the relative social value to Glasgow City of the University International Conference impact. Based on fundamental welfare economic principles, appropriate social weights are derived to convert original impact estimates into socially modified economic values.

The social weights are designed to reflect the dimensions of inclusive growth, including income distribution and deprivation, as recently set out by the Scottish Government. Comparisons with the weighted impacts of other activities on the communities of Glasgow are made and conclusions drawn.

International Competitiveness in EU based on balanced domestic trade estimates

Topic: Globalisation and some effects on SUT compilation relevant for users
Author: Pedro MARTINS FERREIRA

A new methodology for balancing international domestic trade was developed at the European Commission, Eurostat, during the FIGARO project. As a result, a reference data set for trade statistics was built which contains a consolidated view broken down into quasi-transit trade, domestic trade and re-exports. The QDR methodology is able to provide information for several indicators but probably the most important is that of domestic exports, in other words, exports between a country of origin and a country of destination that originated in the economy of the exporting country.
This paper examines the development of domestic trade in EU countries over the 2010-2017 period. International competitiveness for a selected group of commodities will be assessed over the balanced domestic trade estimates, instead of the usual raw estimates of one of the trade flows, providing a more accurate view on international competitiveness.

Impacts of producing electrically driven vehicles on Japan industrial output

Topic: Thematic IO analysis: Life-styles, environment and economy
Author: Takayuki Mase

Electrically driven vehicles could be adopted gradually to achieve an emission reduction target under the provisions of the agreement in the 21st session of the Conference of the Parities (COP21). Under such circumstances, the Japanese government advocates the long-term goal of producing all new vehicles to be electric in Japan by 2050. Because of the difference between body structures of internal combustion engine vehicles and electrically driven vehicles, producing electrically driven vehicles may create different impacts than internal combustion engine vehicles on industrial outputs that potentially rises a national concern considering that the automotive industry is a key industry in the Japanese economy.
 To evaluate these impacts by employing the Leontief production model, we estimate sectoral classification of electrically driven vehicles, including "hybrid vehicles (HV)," "plug-in hybrid vehicles (PHV)," and "battery electric vehicles (BEV)," on the input–output table published by the corresponding cabinet office of Japan. In particular, these sectors reflect the intermediate demand of electric machine components, such as "motor," "rechargeable battery," and "power control unit" in each input structure. Under the BEV sector, we consider the change in input structure as internal combustion engine becomes irrelevant.
 Moreover, this paper presents the results of the sensitivity analysis to evaluate the impacts of producing electrically driven vehicles instead of ICE on Japan industrial output.

The Macroeconomic Consdequences of Regional Fiscal Decentralisation

Topic: IO modeling: Computable General Equilibrium Modeling and Social Accounting Matrices
Author: Peter McGregor
Co-Authors: Katerina Lisenkova, Graeme Roy, Kim Swales

There is considerable momentum in the UK, Europe and across the world towards greater decentralisation of fiscal powers. The devolution of powers over public spending is typically motivated in terms of the efficiency gains emphasised by the fiscal federalism literature. The devolution of tax powers is often advocated on the basis of improved accountability and the enhanced incentive that such powers provide to Sub Central Governments (SCGs) to pursue growth-promoting policies. In this paper we explore the sensitivity of regional economies to the nature and extent of fiscal decentralistion. At one end of the spectrum – one which broadly characterises many UK regions - SCGs' expenditures are governed by a block grant system, with very limited (if any) devolution of taxes. At the other end is full fiscal autonomy – control over public spending and universal autonomous taxes. And there are several options in between. The key question is whether greater regional fiscal autonomy improves SCG's incentives to pursue growth-enhancing policies.

The OECD makes a distinction among "strict tax sharing", "soft tax sharing" and "autonomous taxes" (Blöchliger and Nettley, 2015). Under strict tax sharing tax revenues accrued by the SCG meet an "individual proportionality" criterion (Blöchliger and Petzold, 2009); the revenue generated to the SCG from a tax is strictly related to the amount of revenue generated on its territory. Soft tax sharing refers to instances, like the Australian General Sales Tax (the equivalent of value added tax), where revenues are collected centrally and redistributed across the Australian states based on need. The rates and revenues associated with autonomous taxes are controlled by the SCG.

In this paper we use an intertemporal computable general equilibrium (CGE) model, calibrated on a social accounting matrix of a SCG region, Scotland, to explore the macroeconomic consequences of a range of regional fiscal frameworks that capture, in a stylised manner, key aspects of actual regional fiscal frameworks. In particular, we assess the extent to which greater regional fiscal autonomy improves the incentive to pursue growth-enhancing policies.

Keywords: Sub Central Governments; Regional fiscal autonomy; computable general equilibrium.

JEL codes: D58, R13, R15, H24, H71

Trade War!

Topic: Issue in modelling international trade
Author: Douglas S. MEADE

Current US trade policy is marked by a sharp break with recent precedent. Whereas the US has traditionally had a relatively open economy, protectionist sentiment is rising, and protectionism is indeed one source of Trump's ability to win the 2016 US Presidential election.

Over the past 20 years, the US has contributed to the increased globalization in international trade in goods and services by maintaining an open economy, with origination and participation

in many multilateral free trade agreements, particularly with its two largest trading partners Mexico and Canada. However, the largest source of imports to the US is China, which is also the 3rd largest destination of US exports. The bilateral trade deficit with China has been steadily increasing, and various practices adopted by China are viewed as unfair by US companies, voters and politicians. This is particularly true in the area of intellectual property (IP).

Since May, 2018 the Trump Administration has proposed steep Section 301 tariffs on a large number of Chinese products. Starting in January 2019, 25% tariffs on up to $250 billion of Chinese merchandise import categories are scheduled to take effect.

This paper examines the economic impacts of these tariffs using the Inforum models of the USA and China, linked in a bilateral trade modeling system (BTM). We also examine the impacts of the retaliatory tariffs proposed by China. We begin by identifying the types of goods that are subject to the tariffs, using tables published by the US Trade Representative. Using bilateral trade data based on UN Comtrade and other sources, we then translate these tariffs into impacts by commodity sector in the US Inforum model called Lift. The first round of impacts include higher import prices and reduced imports by the US of imports of Chinese goods. The impacts show up in the China model Mudan as reduced exports. The retaliatory tariffs instituted by China increase costs of US goods to Chinese consumers, and reduce Chinese demand for US exports.

In addition to the bilateral effects between US and China, there are global impacts. To the extent that the growth of the China and US economies is reduced due to the tariffs, this reduces demand by these countries on products of many other countries. We will estimate not only the impact on trade between the US and China, but also with other partner countries.

Understanding Agriculture-Industry Inter-Linkages for Agrarian Development: Empirical Evidence from India

Topic: DP4 Discussants: Kirsten Wiebe, Shigemi Kagawa
Author: Sahil Mehra

The paper examines the changing linkages of the Indian agriculture sector with the industrial sector over the course of economic development as achieved in the last three decades. The Indian agriculture sector has been distraught with socio-economic distress, which has exacerbated in the last two decades. Against this background, the study aims to analyse at a disaggregated level the interdependency of the agriculture sector with the industrial sector and how it has changed over time. This is done by the means of calculating relative linkages, backward and forward linkages. For the same, Input-Output Transactions Tables have been used for the years 1973-74, 1979-80, 1983-84, 1989-90, 1993-94, 1999-00, 2003-04 and 2007-08, as prepared by Central Statistical Organisation. The tables are converted to constant prices to make them comparable over time. The paper adds to the structural transformation literature by providing a disaggregated analysis with detailed focus on intra vs. inter sectoral linkages, which further make the conclusions to be unique. The study concludes that over the years the linkages have weakened with the industrial sector. It was only after 2003-04 that linkages started improving. However, a disaggregated analysis highlights that inter-linkages have improved with the sub-sectors of the industry like chemicals industry, metal products, food-processing industry, electrical machinery, and transport equipment, some of which have significant presence in the unorganised sector. Moreover, after 2003-04, intra-linkages of the agriculture sector have also increased drastically. This points out that at a disaggregated level, the agricultural sub-sectors depend upon their parent sector both for their input requirements and to sell their output. The

results question the hope of modernisation of agriculture sector and falling structural push and pull side incentives arising from the growth of industrial sector.

Extending a standard accounting framework to account for non-linear technological change

Topic: Input-output and sectoral macro-econometric modelling: Part of the same family
Author: Jean-Francois A Mercure
Co-Authors: Hector B. POLLITT, Richard Lewney

Session title: Input-output and sectoral macro-econometric modelling: Part of the same family

(1) Research question
Innovation theory has shown that technological change tends to come in waves. Rates of adoption of new technologies are highly non-linear and have been shown to follow an S-shaped pattern as products move from niche market positions to rapid uptake and, eventually, market saturation. Existing macro-sectoral economic models, which typically build on a linear input-output core, are not well equipped to deal with the diffusion of new products and non-linear technological change. For example, optimisation models assume instant take-up if products become cost-competitive and econometric approaches require historical data that will be missing for new products. At the same time, modellers are grappling with attempting to model technological transitions, notably the transition to a low-carbon economy. Conventional models have repeatedly underestimated the rates of uptake of new low-carbon technologies. Modelling technological change correctly becomes particularly important for problems related to energy, greenhouse gas emissions and sustainability, where other econometric or input-output methodologies would generate inaccurate estimates of energy intensity and environmental damage variables.

(2) Method used
This paper introduces a new modelling approach of technology diffusion. It shows how such a model may be linked to an input-output model and discusses consistency with the assumptions that underpin macro-econometric and Computable General Equilibrium (CGE) models. We use a system of coupled non-linear finite differences equations to simulate S-shaped diffusion curves for the diffusion and phase-out of technologies in energy-intensive technologies (power generation, transport, industry, household heating). This enables to better estimate the energy and greenhouse gas intensity of technology.

(3) Data used
We use a combination of energy statistics and manufacturer data.

(4) Novelty of the research.
We conclude this paper with some examples of the benefits of such a combined modelling framework, focusing particularly on the interactions of technology with the economy and input-output structure. We show how the approach was applied to produce the estimates of the value of stranded fossil fuel assets that were covered extensively by the British media in 2018 (https://www.nature.com/articles/s41558-018-0182-1).

Extended Supply-and-Use Tables for Belgium: where do we stand? An overview of achievements and outstanding issues

Topic: Globalisation and some effects on SUT compilation relevant for users
Author: Bernhard MICHEL
Co-Authors: Caroline Hambÿe, Bart HERTVELDT

In supply-and-use and input-output tables, firms are traditionally grouped into industries according to the type of goods and services they produce. Within these industries defined in terms of product similarity, technological homogeneity has been taken for granted. However, as value chains have become increasingly fragmented and global, within-industry patterns of specialisation have developed, which do not depend on the types of products delivered by firms but are related to other firm characteristics such as size, ownership or exporter status. This has been largely documented in empirical research on firm heterogeneity (e.g. Bernard, Jensen and Schott, 2009). The aim of so-called extended supply-and-use and input-output tables is to take such heterogeneity into account by developing tables in which industries are disaggregated according to these firm characteristics.

Recently, there has been growing interest for such extended tables and the OECD and Eurostat have encouraged NSOs to start producing them. In this context, the aim of this contribution is to take stock of work that has been done on extended supply-and-use and input-output tables for Belgium both in terms of statistical methodologies for constructing such tables and in terms of their use for analysis. We will briefly cover past work on export heterogeneity in manufacturing based on 2010 tables (Michel et al., 2018) and then focus on ongoing work regarding the extension to employment indicators. Moreover, we will inform on where we stand in terms of producing extended supply-and-use tables for Belgium for 2015 with extra disaggregations in terms of ownership and size. To conclude, we will provide an overview of outstanding methodological issues, such as the extension to service industries, row splits, exports through wholesale traders or proportionality in vector construction, and we will indicate possible solutions.

Identifying Critical Supply Chain Paths and Key Sectors for Mitigating PM2.5 Mortality in India

Topic: Thematic IO analysis: Energy and Environment
Author: Haruka Mitoma
Co-Authors: Fumiya NAGASHIMA, Shigemi KAGAWA, Keisuke NANSAI

Today, fine particulate matters (PM2.5) and these precursors are known as critical factors that affect adverse environmental impacts and human health. In recent years, India has been achieving remarkable economic growth and emitted a lot of air pollutants in the manufacturing processes, which led to 1 million deaths attributable to PM2.5 exposures in 2015. Especially, power sector has contributed to air pollution in India through increasing direct and indirect electricity demand due to industrialization. In order to discuss solutions for mitigating health impacts, it is necessary to clarify the economic activities in India and identify the key factors for the PM2.5 emissions from the power sector. In this study, we focused on the PM2.5 emissions from the power sector in India and calculate consumption-based health impacts due to the PM2.5 emissions from coal-fired power plants using the Eora multi-regional input-output database. Due to the lack of detail database that converts PM2.5 emissions including primary and secondary particles to premature deaths, we made a new health impact inventory database at sector level using atmospheric chemical transport model and existing epidemiological methods. Then we identified the critical supply chains in terms of PM2.5–induced health impacts using the structural

path analysis (SPA). We linked the supply chain paths and transboundary atmospheric transport of air pollutants. The result shows that the total deaths attributable to PM2.5 emissions from power sector in India are 12 million, 10 million of which were resulted from domestic demand and 2 million was from other countries where the consumption from US contributed most. We also found that the path "US (drivers)-->India: Oil & Non-metallic mineral products-->India: Power (source)-->India (receptor)" had the biggest health impacts. The US demand on textile and apparel sector also indirectly induced the health impacts in India through the electricity production in India.

Electromobility 2035 - Effects on the economy and employment through electrification of the powertrain of passenger cars

Topic: Classical IO applications: Economic Structural Change and Dynamics
Author: Anke M. MOENNIG

The automotive industry is one of Germany's leading industries. Due to its high share of value added, its high export quota and its high direct and indirect number of employees, the automotive industry is regarded as systemically relevant and therefore receives a high degree of political, economic and social attention. The industry is currently in a phase of upheaval: suspected cartels, software manipulation, driving bans for diesel vehicles, the planned end of the combustion engine in France or Great Britain, e-quotas in China or EU fines for increased carbon dioxide emissions from 2020 (<95 grams of CO_2 per kilometre) and 2030 (35% less than 2020) are urging manufacturers to make changes and are currently promoting the development of battery-operated cars in particular.

The transformation process towards the electrification of powertrains is likely to have a major impact on the German economy in general and on the German labour market in particular. By applying an input-output-based, economic modelling approach and by combining it with scenario technique, this paper aims to quantify the effects of the electrification of the powertrain of passenger cars in Germany on employment. The macroeconomic input-output model IAB/INFORGE can describe in detail the labour market by differentiating employment by sectors, occupations and by requirement level. The bottom-up structure of the model allows formulating industry-specific assumptions. With the help of the scenario technique, a what-if analysis is started that distinguishes between two worlds with a strong electrification (electrical share will be 23 percent in 2035) and a less strong electrification (electrical share in passenger cars remains roughly at its current level) of the powertrain.

Compared to the baseline scenario, the shortrun results show a positive growth and employment effect, but in the long term a lower gross domestic product and employment level will have to be expected. While in the beginning the necessary additional investments of the automotive industry, the construction investments in the charging infrastructure and the re-equipment of the power grid will have a positive effect, in the long run the increasing import demand for electric cars and traction batteries will dominate. With the exception of training costs, the cost effects also have a negative impact on the economy as a whole, but are far less dominant. The positive effect from the change in fuel demand - electricity instead of mineral oil - also cushions the negative impulses. The productivity-related growth and employment impulses, which will only take effect in the long term, cushion the largely import-induced decline in economic momentum on the one hand, but on the other hand contribute to the relatively strong overall job loss.

Compared to other related studies, this paper applies a sophisticated approach to project likely employment effects in the long run. The focus lies on the effects on labour demand not only by sectors but also by occupations and requirement levels. Moreover, the bottom-up structure allowes for sector specific assumptions.

Functional income distribution, labor productivity and technological change in input-output matrices: an approach of complexity to the Mexican case.

Topic: Mathematical Analysis and Thematical Applications
Author: Eduardo MORENO REYES
Co-Authors: Martín Carlos PUCHET ANYUL

The importance of the Functional Income Distribution (FIN) is not simply to understand the configuration of the primary payments in the production process of an economy, but in this lies the primal step of the entire distributive and redistributive process in an economy. This paper have two motivations; first, to expose the possibility of interpreting the sectorial circularity indexes (SCI) (Latner 1972, Gazon 1976) of input-output table as an indicator that captures the complexity and technological change of an inter-industry system; second, to answer the question: "Is the complexity and cost of new technologies and their impact which changes the structure of income and labor-saving and modify the production function towards more capital intensive methods? ".

The SCI is an indicator that allow to measure the technological change and the complexity of the network associated with an input-output table. Therefore, when this indicator is related to labor productivity and the FIN through econometric panel model, the question formulated in the second purpose can be answered; in turn, to establish if the variables maintain a long-term relationship.

The respective indicators are estimated with the information of the tables of input - output for Mexico in three key years 1980, 2003 and 20008 – and considering compatible disaggregation levels. Data sources to be used are provided by the Statistic and Geography National Institute (INEGI).

While there have been studies analyzing the circularity index, an indicator that synthesizes without losing information the circular relationships represented by a table of input-output, no studies have been done to take this indicator as representing technological change and complexity and, even less, research has been conducted to consider this indicator of a joint form with labor productivity to determine the functional income distribution; the mode of distribution less addressed in the economic literature, however, its importance.

Transforming a Rectangular Input-Output Model into the Coordinates with Respect to Eigenbasis

Topic: IO Theory: Advances in input-output theory
Author: Vladimir MOTORIN

A rectangular input-output table with N products and M industries is defined by production matrix X and intermediate consumption matrix Z with N rows and M columns both. The square matrices FF'= (X–Z)(X–Z)' of order N and F'F=(X–Z)'(X–Z) of order M are symmetric and have the same spectrum of nonzero real eigenvalues.

The eigenvectors of matrix FF' form an orthonormal basis of N-dimensional vector space that could be considered as eigenbasis for rectangular input-output model at N>M (i.e., the number of products exceeds the number of industries as it often happens in statistical practice). Being transformed with respect to the eigenbasis, matrices X and Z have N–M lower rows coincided between each other (with zero final demand for the last N–M products). This property allows employing rectangular input-output table written in the coordinates with respect to the eigenvectors of matrix FF' as operational demand-driven input-output model in which M components of final demand are exogenous variables and the other N–M components are set to

zero.

In turn, the eigenvectors of matrix F'F make an orthonormal basis of M-dimensional vector space that could serve as eigenbasis for rectangular input-output model at M>N (i.e., the number of industries exceeds the number of products). Being transformed with respect to this basis, matrices X and Z have M–N right columns coincided between each other (with zero value added in the last M–N industries). Thus, rectangular input-output table written in the coordinates with respect to the eigenbasis can be used as operational supply-driven input-output model in which N components of value added are exogenous variables and the other M–N components are set to zero.

The analytical opportunities of practical applying the proposed models are slightly limited because of explicit shortage of exogenous variables. Nevertheless, It is shown that the models appear to be a useful additional toolbox to regular computational schemes of input-output analysis. Their main advantage is direct handling the initial rectangular input-output table without obvious data distortion being entailed by transformations the table to symmetric format under various assumptions.

Economic Transformation of Japan, 1885-2015: Supply Side Approach

Topic: IO Applications: Structural change, trade and dynamics
Author: Kakali MUKHOPADHYAY
Co-Authors: Partha Pratim Ghosh

Proposed Special Session
1) Title of the Organised Session:
Structural transformation in Asia: Lessons from Pre and Post-World War to Asian Crisis
2) The names and institutional affiliations of the organizers:
Kakali Mukhopadhyay, Professor, Gokhale Institute of Politics and Economics, Pune, India and Adjunct Professor/ Senior Fellow, Department of Agricultural Economics, McGill University, Montreal, Canada

Title of the Abstract
Economic Transformation of Japan, 1885-2015: Supply Side Approach

Authors:
Partha Pratim Ghosh, St. Xavier's College, Calcutta, India & Kakali Mukhopadhyay, Gokhale Institute of Politics and Economics, Pune, India Department of Agricultural Economics, McGill University, Montreal, Canada.

Abstract

Over the past two centuries, many industrialized countries have experienced dramatic changes in the sector level composition of output and employment. The pattern of structural transformation, depicted for most of the developed countries, entails a steady fall in the primary sector, a steady increase in the tertiary sector, and a hump shape in the secondary sector. Since Japan is an important economy in the present world, it is essential to study the process of transformation in this country. The growth rate of the Japanese gross domestic product was significantly higher in the post-war era (1955-1985) compared to the pre-war era (1885-1935). Investigations on structural transformation have been generally carried out using the demand driven Leontief Model. However the Ghosh model can be used to provide additional insights on the process of

transformation.

The objective of the present study is to estimate the effects of cost push in the Input-Output model and also the sector level changes in productivity for Japan during the period 1885 to 1985. The above empirical investigations can be carried out using the Japanese IO tables under alternative Ghosh assumptions. The present paper uses thirteen input-output tables each of seven sectors available between 1885 and 1985 (Shintani, 1988) to investigate the above mentioned issues. For these exercises, a comparison is made between the pre-World War(II) and post-World War(II) periods. The exercise is expected to throw light on the process of structural transformation of the Japanese economy and provide some direction for policy making.

Economic Accounting of Water Use and Wastewater generation in India

Topic: Addressing Strategic Challenges of the 21st Century: Deepening the Collaboration between Input-Output Economists and Industrial Ecologists
Author: Kakali MUKHOPADHYAY
Co-Authors: Partha Pratim Ghosh, PAUL J. THOMASSIN

1) Title of the organized session
Addressing Strategic Challenges of the 21st Century: Deepening the Collaboration between Input-Output Economists and Industrial Ecologists

2) Name and institutional affiliation of the organizer
Faye Duchin
Professor of Economics (retired)
Rensselaer Polytechnic Institute
Troy, NY USA

Title of the Abstract
Economic Accounting of Water Use and Wastewater generation in India

Authors:
Kakali Mukhopadhyay, Gokhale Institute of Politics and Economics, Pune, India, and Department of Agricultural Economics, McGill University, Montreal, Canada.
Partha Pratim Ghosh, St. Xavier's College, Calcutta, India
& Paul J. Thomassin, Department of Agricultural Economics, McGill University, Montreal, Canada.

Abstract
India is a water-stressed country. The Environmental Accounts of the Govt. Of India estimates the per-capita water availability in India at 1421m3 per annum in 2021 and projects it to decrease continuously through 2050 when it is expected to reach 1174m3 per annum .

The bulk of water resources of India are used for agricultural purpose and a relatively small proportion is used for industrial, household and other purposes. Surface water and ground water are the two main sources. The rivers generate an annual average water resource potential of 1869.37 billion m3 (BCM), the utilizable surface water resources stand only at 690.1 BCM annually. The Central Ground Water Board estimated the annual replenishable ground water at about 447 BCM in March 2013. The main source (67%) of recharge for groundwater is the south-west and north-east monsoon rainfalls. In recent times, the annual rainfall in India has been

showing mostly negative departures from the normal, sometimes as much as 12% as in 2014 or 9% in 2015 and 2016. Since a major proportion of total irrigation comes from ground water, the depleting reserve of ground water is affecting the total area of cultivated land. The stage of development of ground water is defined by the total draft of ground water for all purposes as a percentage of the net annual groundwater availability. Between 2004 and 2013, vast tracts of land mainly on the western part of the country have increased their stage of development of groundwater from 0-50% to 50-100% clearly indicating the stress endemic to the system.

As we move forward on the path of development, the demand for production in agriculture industry and services is expected to be on the rise along with increasing targets for economic growth, putting further pressure of the water availability. Together with the expected increase in demand, some of the major causes of water stress identified are: Over exploitation of ground water; Intrusion of sea water; Low infrastructural development and low utilization of existing facilities and inefficient water usage. Another pressing concern is wastewater from industries, agrochemicals, fertilizers, and organic manure. Wastewater amount is increasing significantly and polluting the existing freshwater reserves.

Therefore proper projections of water demand and generation of wastewater along with policies to ameliorate the water stress are imperative in India. Estimation of water footprint or its analogue virtual-water is a major task in this area. Generally agro-scientists estimate use evapo-transpirational coefficients to estimate the use of Green, Blue and Grey water in agricultural activity. Similarly, experts in industry and services also use technical methods to estimate their respective water requirements.It remains up to the economists to assess economy-wide water footprint of India. In this context the Input-Output methodology can be used as a very powerful tool to give a correct picture of inter-sector flows of water both through the production that is drafted via final demand as also the inter-regional and international trade flows that occur within the domestic boundaries and outside it. Further, the study calculates the generation of wastewater from the domestic economic activities and its trade counterpart. The paper will also assess the use of appropriate technology to reduce water consumption. This type of an exercise will develop a blue-print for future policy and course of action with respect to the evolving water scenario in India.

Towards input-output based measurements of trade creation and trade diversion

Topic: Trade in Value Added and "servicification" of the Global Value Chains
Author: Kirill MURADOV

Trade creation and trade diversion are popular notions to explain the effects of trade agreements. Although these were proposed by Jacob Viner nearly 70 years ago and motivated a large body of research literature, estimating trade creation and trade diversion is still not an easy task. Most studies have so far employed the gravity model and econometrically estimated the relevant changes in trade flows.

This paper discusses a new approach to quantify trade creation and trade diversion that relies on the structural decomposition analysis in an inter-country input-output framework. In a country pair, trade creation is defined as a substitution of domestic intermediate inputs and final products by those imported from the partner country. Trade diversion, respectively, is a replacement of third country products by the partner country products in domestic intermediate or final use. For an exhaustive accounting of changes in the country of origin of inputs and final products, the

paper introduces a third effect where domestic products replace partner country products. This effect may be recognised as import substitution and is called here trade contraction. Creation, diversion or contraction of trade flows are intrinsic to any pair of countries that may or may not be linked by a trade agreement.

The proposed method decomposes the GDP change into changes in the country of origin of products for intermediate and final demand, splitting these into trade creation, diversion and contraction, and four other factors. For each country pair, the said trade effects are captured with respect to the home country, partner country and rest of world, but can be easily aggregated.

The new method is put to test using the 2016 edition of the OECD Inter-Country Input-Output (ICIO) tables, aggregated to 32 countries. The period under study spans 2000 to 2011.

The calculation uncovers a great deal of detail on trade creation, trade diversion and trade contraction at the bilateral country level. Together, the three effects tend to neutralise each other, and their joint contribution to the GDP growth is far from significant. It is also shown that net trade creation (diversion, contraction) for the world as a whole is zero in monetary terms. The analysis of time series reveals a surge of trade contraction in 2008-2009 that coincides with the great trade collapse and a surge of trade creation in the following year. Trade in final rather than intermediate products was largely responsible for these fluctuations. This paper did not find evidence that the rise of free trade agreements in 2000s had been associated with higher magnitude of trade substitution effects for an average country pair in terms of GDP growth.

This study is thought to lay ground for a wider use of input-output techniques for the analysis of trade creation and related effects. Feasible extensions include, but are not limited to, estimation of the re-distribution of income at the sectoral level and ex-ante modelling exercises.

Textile and Apparel Employment, Trade and Economic Development in Pakistan

Topic: IO Applications: Structural change, trade and dynamics
Author: Khansa NAEEM
Co-Authors: Muhammad Aamir KHAN

The overarching importance of trade has been recognized as major component of sustainable development goal. Export oriented trade policies help a country in efficient distribution of resources, helps it to achieve internal and external stability and interlink different economies by mutual transfer of benefits. The present global value of Textile and Apparel (T&A) is US$296.1 billion and US$ 454.4 billion. The cumulative percentage share of T&A in world manufacturing exports is 6%and employing around 120 million which is augmenting its economic significance. T&A industries are prime export industries which helped low- income countries like Pakistan in uplifting socioeconomic growth by its industrial expansion. T&A industries accounts for 61% in Pakistan's total export and employed 40% of country labor. The provision of GSP-Plus status allowed duty free entry of Pakistan's commodities to EU. The LDC graduation of Bangladesh and potential decline in china exports provides Pakistan an opportunity to cater huge market of EU and USA. Given this new backdrop, this study will use a global computable general equilibrium model calibrated using latest social accounting matrix of Pakistan (SAM,2013) to analyze how T&A industry through international trade play a crucial role in creating jobs, promoting economic development, reducing poverty and income inequality in Pakistan. This extended model includes detailed information on country's labor and household groups from latest SAM and latest GTAP

database using MyGTAP approaches. Preliminary results shows an impact on global supply chain of T&A. Results also show a positive impact on Pakistan's real GDP, sectoral export, sectoral import and household level.

Spatial Structural Decomposition Analysis with a Focus on Product Lifetime

Topic: Thematic IO analysis: Transport & Policy Analysis &
Author: Yuya NAKAMOTO

A lifetime extension of a product reduces the demand of consumers for that product (Serrenho and Allwood, 2016), and hence reductions of intermediate input and energy input for the production of the product can be achieved (Kagawa et al., 2008). However, previous studies on automobile lifetime analysis have the following issues: (1) The scope of previous automobile lifetime studies has been domestic, whereas the supply chain of automobiles is global in scale; and therefore (2) It is unclear what impact changes in product lifetime in a country have on the structure of final demand through the global supply chain and carbon footprint associated with the global final demand.
To address these issues, this study estimated the carbon footprint associated with the global final demand of automobiles and auto-related petroleum of the U.S.A., Germany, and Japan, which account for 31% of the stock of passenger cars in the world in 2009, during 1995 to 2009. Using the World Input-Output Database (WIOD) (Timmer et al., 2015), we developed a comprehensive new method that offers a deeper understanding of the structural change in the global final demand of automobiles and discussed how the lifetime of automobiles of a specific country has contributed to their carbon footprints. From the results, we found that automobile lifetime extensions of the three countries greatly reduced their carbon footprints, and had a greater effect than technological changes in emission intensities of suppliers directly and indirectly involved in automotive manufacturing.

Impacts of Processing Trade on Productivity in Malaysia

Topic: Classical IO applications: Trade, Outsourcing and GVCs
Author: Nik Rozelin bt Nik Ramzi Shah
Co-Authors: M. Yusof SAARI, Muhammad Daaniyall Abd Rahman, Chakrin UTIT

Processing trade refers to sectors located in free industrial zones (FIZs) that produces final goods using parts, components, accessories and packaging materials from abroad with free of duty. Although the contribution of processing trade sectors on domestic economy are well documented in the literature, studies on measuring the impacts of these sectors on productivity are limited. This paper aims to measure the extent to which processing trade sectors affect productivity by taking Malaysia as a case study. Malaysia is considered as an interesting case because it is recognized as one of the Asian countries actively participate in processing trade activities with strong support from the government. For empirical analysis, we utilise the extended input-output table for Malaysia that separates sectors into the processing trade and normal trade. Database from national economic census, trade statistics and companies registrar are used to split the sectors into processing and normal trade sectors. To enable for the productivity assessment, additional information for employment and wages by sectors are included in the dataset. This work is not only contributing to the current literatures on productivity analysis within the input-output analysis sphere, but the present results also able to determine the capability of

processing trade sectors to exhibit high productivity level. Additionally, it will become a significant policy input for the Malaysian government to initiate targeted interventions to generate sustainable growth.

Structural propagation in a production network with restoring substitution elasticities

Topic: Methodological aspects of input-output analysis
Author: Kazuhiko NISHIMURA
Co-Authors: Satoshi NAKANO

We model an economy-wide production network by cascading binary compounding functions, based on the sequential processing nature of the production activities. As we observe a hierarchy among the intermediate processes spanning the empirical input–output transactions, we utilize a stylized sequence of processes for modeling the intra-sectoral production activities. Under the productivity growth that we measure jointly with the state-restoring elasticity parameters for each sectoral activity, the network of production completely replicates the records of multi-sectoral general equilibrium prices and shares for all factor inputs observed in two temporally distant states. Thereupon, we study propagation of a small exogenous productivity shock onto the structure of production networks by way of hierarchical clustering.

Effects of lifestyle changes on carbon emissions in Malaysia for periods 2010-2015

Topic: Thematic IO analysis: Energy and Environment
Author: Umi Zakiah NORAZMAN
Co-Authors: M. Yusof SAARI, Muhammad Daaniyall Abd Rahman, Chakrin UTIT

Studies show that household consumption is responsible for nearly three quarters of global carbon emissions. The level and pattern of carbon emissions contributed by household depend on their lifestyle that largely determined by the income level and standards of living. Thus, understanding the link between lifestyle and carbon emissions is important if we are to make progress towards a low carbon future. This paper aims to measure the impacts of lifestyle changes on carbon emissions in Malaysia for periods 2010-2015. An extended input-output table that combined with household expenditure surveys are used to model the impacts. In our extended input-output table, we introduce two vectors: (i) sectoral energy consumption in physical units that compiled from official census and (ii) sectoral carbon emissions that estimated separately. For a better policy design for households, we detail the consumption in household expenditure surveys by taking into account heterogeneity of households among different income groups across geographical locations. For Malaysia, this paper answers critical and policy relevant questions such energy efficient and the conservation initiatives under the Malaysia Energy Efficiency Action Plan and Eleventh Malaysia plan. For developing countries as a whole, it addresses the importance to have appropriate framework for measuring carbon emissions from consumption that taking into account heterogeneity of households.

Accounting for Africa between Bottom and Top: social accounting frameworks for epidemics and revival

Topic: Murals and miniatures: applying social accounting with a very broad brush, and with fine strokes to precious cameos
Author: Nicho Mojalefa Ntema
Co-Authors: Hervey Gibson

The SAFER social accounting framework programme has three aims:
1.   Developing African capacity to measure the economy and society, especially the informal
2.   Measuring the holistic, society-wide economic role of health and caring, with attention to epidemics including HIV
3.   Working with people so the research makes a difference on the ground and in the air, as well as in academic, policy and business circles.
This paper spans the very large continent-wide Social Accounting framework in Pillar One and the first-ever quantified socio-economic model of an apartheid-era Township in Pillar Three. Within the structural envelope of almost all previous tabular and classification systems used for SAMS across the continent, we investigate meaningful models and meta-analysis for plugging gaps between intergovernmental data downwards, street surveys upwards, and national statistical institutes in-between.
The programme creates and applies tools to interpolate, extrapolate, and translate:
•   across the supply and use of products in industries and societies
•   geographically across jurisdictions, localities, regions and countries
•   temporally between sporadic surveys and the present.
From the top down we use extant globally coordinated data and estimates from intergovernmental institutions', WIOD and GTAP, and trade from Comtrad and its diaspora. We update using 'nowcasting' techniques, some theoretically agnostic and some drawing on straightforward models with theoretical underpinnings, such as AIDS and KLEMS. We disaggregate by successively partitioning the prior estimates on the basis of both product and place/jurisdiction – going back to question the prior estimates where that is indicated.
The research philosophy is one of early exposure to encourage constructive criticism. In 2019 we will publish informal drafts of a 'continental' African SAM, and of a SAM for South Africa disaggregated by region and settlement type. These link to a SAM of Sharpeville, engaging locals and fostering economic development in a place originally designed to be economically barren.

Estimating the Trade and Welfare Effects of Brexit

Topic: Modelling the effects of Brexit II
Author: Harald Oberhofer

This paper proposes a new panel data structural gravity approach for estimating the trade and welfare effects of Brexit. Assuming different counterfactual post-Brexit scenarios, our main findings suggest that UKs exports of goods to the EU are likely to decline within a range between 7.2\% and 45.7\% six years after the Brexit has taken place. For the UK, the negative trade effects are only partially offset by an increase in domestic trade and trade with third countries, inducing a decline in UKs real income between 0.3\% and 5.7\%. The estimated welfare effects for the EU are not different from zero.

Extended Input-Output Model for Demographic Change – Preliminary Application to the Chinese Urbanisation

Topic: Structural Change and Economic Growth
Author: Nobuhiro Okamoto

China carries out "Urbanisation" as an economic policy which intends to concentrate people in the urban area and boost the whole economic growth on the basis of "Economy of Agglomeration" struggling with the pressure of "middle-income trap" or "new normal." The research question here is about how the labour migration from rural areas to urban areas has an economic and industrial impact on the Chinese economy, and whether or not the geographical change between space is truly beneficial for Chinese economic growth in the near future. To answer these question, this research develops the extend input-output model based on the previous research such as Batey (2018) and their other research, which focus on incorporating labour account with Input-Output model. In this original model, the Input-Output model has been developed into the economic model with a household which takes account of immigrants from other regions, people who are out of work, and ordinary labour force. This study develops this extended Input-Output model for demographic change, in particular, change of population movements from villages to cities in China since the urbanisation process is seen as the continuous concentration of people in the certain areas, especially, cities. The study will illustrate the preliminary results in the case of China by using this model. Furthermore, the paper will discuss the possibilities of a wide range of application of the Input-Output table in terms of demography.

Some IO applications with complications

Topic: Methodological aspects of input-output analysis
Author: Jan Oosterhaven

This chapter of my upcoming book on Input-Output Analysis deals with three types of applications of IO analysis that regularly appear in the literature without any consideration of their limitations, namely (1) regional and interregional forward and backward linkage analysis, better known as key sector analysis, (2) structural decomposition analysis, especially, of national and interregional economic growth, and (3) economic impact analysis, especially, of negative supply shocks caused by, for example, natural and man-made disasters. In all three cases, the standard approach is shown along with its problematic implications, such as presenting policy makers with only half of the truth in the first two cases, and producing misleadingly high multipliers in the last case. Of course, the necessary additions to and changes in the standard approach are indicated as well.

Economic Analysis of Multinationals Firms in the UK after Brexit

Topic: Modelling the effects of Brexit II
Author: Gabriela Ortiz Valverde
Co-Authors: Maria C. Latorre

Title: Economic Analysis of Multinationals Firms in the UK after Brexit

Research question: this paper provides an impact assessment of Brexit considering the role of

foreign multinationals enterprises (MNEs) in the United Kingdom (UK).

The method used: We use a recursive dynamic computable general equilibrium (CGE) model à la Latorre and Hosoe (2016). The model allows estimating the impact on GDP, welfare, wages, and capital remuneration, together with the evolution of aggregate and sectoral output, exports and imports. In addition, in each sector of the UK economy, the model includes the simultaneous presence of a representative firm for national firms and a representative firm for foreign MNEs. The cost structure of MNEs is different than the cost structure of national firms and the output by sector is depicted by a CES aggregation function of the output of national firms and multinationals. In addition, two separate Armington (1969) CET structures for local firms and MNE affiliates are used for the provision of exports.

Data used: We use the latest version of the GTAP Database (GTAP 9, Aguiar et al., 2016) and the Eurostat (2018) data related to the operations of foreign affiliates. The model includes 21 sectors and three regions: the UK, OECD countries and the Rest of the World (ROW).

The novelty of the research: The incorporation of FDI and multinationals' operations in the analysis of Brexit has received scarce attention in the literature (Fernández-Pacheco et al, 2018a; Fernández-Pacheco et al, 2018b). Only a few CGEs have explicitly modeled both types of firms interacting within sectors (see Tarr, 2013 and Latorre, 2009 for reviews). With this model we can follow the evolution of production and exports by type of firm (i.e., domestic or MNEs), therefore, this study will offer closer results to the potential effects of Brexit.

Regional production and consumption emissions associated with the Danish livestock products – a CGE multi-regional input-output approach

Topic: Modelling Carbon Footprints in the MRIO and CGE frameworks
Author: Albert Kwame Osei-Owusu
Co-Authors: Nino Javakhishvili-Larsen

Regional production and consumption emissions associated with the Danish livestock products – a CGE multi-regional input-output approach

Global protein consumption is expected to rise with the predicted increase in the global population from 7.6 to 9.5 billion in 2050. While production emissions will rise accordingly, they will also partly be driven by higher consumer demand for goods and services. Recent studies have shown the importance of allocating emissions to final consumers based on international trade. Both inter and intra-regional sectoral interactions to satisfy consumer demand result in environmental repercussions such as greenhouse gases emissions embodied in trade. Using a CGE-multi-regional input-output model for Denmark, this study presents an environmental extension of the Local interregional (LINE) economic model, a regional input-output model using regional environmental accounts. Denmark is renowned for its agricultural orientation and high production and consumption of animal products. Our analysis comparatively evaluates the regional production and consumption emissions associated with different livestock products in Denmark. We investigate the carbon footprint of different livestock products with the two separate accounting methods (production- and consumption-based accounting) for five Danish regions. Information generated can be useful in formulating specific environmentally friendly policies associated with regional production and consumption of goods and services. The results achieved constitutes the basis for revealing the hotspots for demand-driven regional emissions

and provide grounds for region-specific climate policies that will either mitigate or preclude national greenhouse gas emissions and carbon leakages between local regions. Furthermore, the model will allow for future regional planning of support for more sustainable food production and consumption (SDG 12), by implementing local bioresource management and technology systems for local alternative protein supply chain lowering the CO_2 footprint of consumption thereby contributing to SDG 13 on climate actions, delivering GHG emission reductions.

Keywords: Multi-regional input-output model, CGE, carbon footprint, livestock products

Structural change and premature deindustrialization in the Democratic Republic of Congo in 1970-2013: An Input-Output Perspective

Topic: DP3 Discussants: Rossella Bardazzi, Doug Meade
Author: Christian Samen OTCHIA

Many Sub-Saharan African countries have experienced rapid periods of deindustrialization despite substantial economic growth and high demand of manufactured goods. The existing growth literature has found that structural change and growth go hand-in-hand and that structural change towards high productive sectors is often associated with industrialization. From these two stylized facts, recent work by development economists has established that Sub-Sahara Africa has failed to industrialize. Several theories on the origin of this premature deindustrialization have also been proposed. However, most studies have only focused on a highly aggregated manufacturing sector, ignoring the existing heterogeneities within the manufacturing sector and the linkages with a highly growing—productive—service sector. Furthermore, most of the evidence on deindustrialization to date is based on cross-country econometric analysis and no previous study has investigated this issues using an input-output framework. In this paper, we comprehensively document the dramatic changes in the manufacturing sector and the large declines in employment rates and uncover economic linkages across sectors and over time that the literature on deindustrialization has had overlooked.

To do so, this study uses a fourteen-sector aggregation of the 1970, 1987, 1997, 2005, and 2013 input-output tables of the Democratic Republic of Congo. For finer analysis of deindustrialization, we breakdown manufacturing industries in detail, in consistent way in all the input-output tables. We make several contributions. First, we build a new input-output table using 2013 as the base year for a country with poor quality data. This new data is combined with the previous input-output tables created by the authors to constitute the largest dataset of input-output tables from developing Sub-Saharan African countries. We then apply the field of influence of coefficients and economic decompositions to explore long term features of structural changes and deindustrialization. The present study appears to be the first attempt to thoroughly examine premature deindustrialization in a natural-resource country.

Rethinking the Social Accounting Matrix Structure for Household Footprints

Topic: New techniques, constructions and applications of Social Accounting Matrices
Author: Anne OWEN

Increasing household demand is the most important driver of increases in global emissions. It is paramount that the method used to calculate the household footprint is robust, accurate and uses the most appropriate source data and model structures. In this paper, I explore how the structure of the standard input-output table can be reconsidered in order to better determine the household footprint.

This paper presents a theoretical Social Accounting Matrix (SAM) with four methodological advances. Since households are consumers of government and capital products via household spend on taxation and savings, it can be argued that the Household Footprint should include the impact of these intangible expenditures. Firstly, I propose that the Social Accounting Matrix (SAM) with household demand as the sole exogenous variable is the most appropriate structure for calculating household consumption-based accounts since it captures all monetary flows in the economy and is not restricted to accounting for physical goods and services.

When calculating environmental impacts associated with consumption, the multiregional supply and use table (MSUT) is widely accepted as the most suitable structure for dealing with impacts embodied in traded goods and where industries produce one or more product types. SAMs have not explored multiregional flows at the same pace and intensity of input-output research, meaning they are limited in their use for understanding embodied impacts in trade. Secondly, I present a new multiregional SAM structure for the calculation of household footprints.

Thirdly, I demonstrate the dualities between footprints calculated using the new SAM structure and footprints calculated with traditional MSUT structures.

Surveys of household expenditure have the potential to be used to disaggregate footprints of household demand by different household types but the surveys often use different product classifications to the MSUT or SAM database. Finally, I show how a SAM structure can incorporate data from different classifications systems in a satisfactory solution.

Assessment of Regional disparities in India: survey-based regional input-output vs a regionalised location quotient based input-output model

Topic: Modelling Carbon Footprints in the MRIO and CGE frameworks
Author: Bhanumati P
Co-Authors: Kakali MUKHOPADHYAY

1)   Title of the Organised Session:
Modelling the Carbon Footprints in the MRIO and CGE frameworks

2)   The names and institutional affiliations of the organizers:
Dr. Nino Javakhishvili-Larsen, Head of Regional Model, Centre for Regional and Tourism Research, Denmark
Prof. Kakali Mukhopadhyay, Gokhale Institute of Politics and Economics, Pune, and Department of

Agricultural Economics, McGill University, Canada

3)   Abstract describing the theme/objectives of the session:
Title: Assessment of Regional disparities in India: survey-based regional input-output vs a regionalised location quotient based input-output model

Authors:
P. Bhanumati, Ph.D. Scholar, Gokhale Institute of Politics & Economics, Pune, India, pbhanumati@gmail.com
Kakali Mukhopadhyay Professor, Gokhale Institute of Politics and Economics Pune, India and Adjunct Professor/ Senior Associate Fellow Department of Natural Resource Sciences Agricultural Economics Program, McGill University, kakali.mukhopadhyay@mcgill.ca

The Indian economy is characterized by unequal distribution of natural resource endowments with imperfect mobility and indivisibility in production factors, imbalance in infrastructure supply and generally, an unequal growth profile of regions. These differences also imply that any economic stimulus will promulgate a different response across various geographical regions. It has been recognised and illustrated, nationally and internationally, that Input Output Transaction Tables (IOTTs) can be used as a tool for planning the regional development by optimizing the sources available in the region. The regional input-output tables can be constructed using survey method or non-survey methods depending on the level of availability of information. In the case of states in India, the investment mandated in terms of labour, time and financial resources for a survey-based method often outweighs the benefits of compiling the regional input-output table using a survey method. However, the model based on survey-methods is expected to be more robust than the model constructed using non-survey methods, like the location quotient method. In this paper, the different coefficients are compared for the two models constructed for a region of India, to understand if there is a pattern and if either of methods is more suited than the other for certain industries/sectors.

Driving forces of changes in CO2 emissions of China

Topic: Modelling energy use and production in interindustry models
Author: Chen Pan
Co-Authors: Jianwu HE, Shantong LI, Dequn Zhou

After the rapid growth in CO2 emissions of China between 2002 and 2007, changes have happened in China's CO2 emissions. After 2007, the growth rate has declined, and the roles of the provinces and sectors have been changing. However, the driving forces behind these changes have not been investigated at the provincial level. To identify the key driving forces behind the changes in CO2 emissions of China, we perform a two-stage, six-factor Structural Decomposition Analysis based on China's most up-to-date provincial Multi-Regional Input-Output tables for the period 2002-2012. The changes are decomposed into effects from changes in CO2 intensity, production structure, sources of intermediate use, sources of final demand, products mix of final demand, and scale of final demand.

The results show that (1) the dominant demand of the growth in China's CO2 emissions has shifted from investment led by the eastern provinces and exports in 2002-2007 to investment alone in 2007-2012, with the largest contribution from the western provinces; (2) the CO2 intensities of resource-based high-emission sectors continuously improved from 2002 to 2012, but some sectors with low final CO2 intensities but high industry chain emissions, such as the

construction sector, indicated high carbonization trend; (3) the changes in the sector structure of final demand have contributed to the increase in China's CO2 emissions, mainly caused by higher shares of electricity and equipment; (4) structure of the product sources helped decrease CO2 emissions in 2002-2007, but led to an increase in CO2 emissions in 2007-2012, mainly because the sources of products have shifted from the eastern provinces with low CO2 intensities to those eastern provinces with relatively high CO2 intensities and the less developed central and western provinces.

These findings suggest that in the future, more attention should be given to the central and western provinces, as well as the rapidly-increasing investments. Not only the improvement of CO2 intensity, but also the decarbonization in production structure should be highlighted. In addition, efforts should be made to improve the demand structure from the perspective of emission mitigation.

Constructing a China's provincial multi-year Multi-Regional Input-Output database

Topic: IO Data: Annual, Regional, and Multiregional Input-Output Accounts and intra- and international Trade
Author: Chen Pan

Unlike small-sized countries, China has a large territory and numerous provinces with different resource endowments, locational conditions, and development foundations. On the one hand, the large variances mean that when investigating issues about China, not only the nation-wide but also the provincial analysis should be involved. On the other hand, these variances lead to a large amount of interprovincial trade and a complex trade network. It is necessary to take the role of trade into consideration when analyzing the economy-related issues. As an efficient method to describe the economic links between regions, the Multi-Regional Input-Output (MRIO) model has been widely used to analyze the economy-related issues, such as carbon emission, pollutions, resources, value-added, etc. However, as China's nation-wide data have been well developed, the regional data are still fragmental. There is a lack of a consistent and complete regional MRIO database with a long time span, especially at the provincial level.

To fill this gap, this study aims to construct a China's provincial multi-year MRIO database with the principles of keeping reliable information as much as possible, following the 'bottom-up' method, using the National Account data as a benchmark, and no entrepôt. We collect Chinese provincial Single-Regional Input-Output (SRIO) tables for 1992, 1997, 2002, 2007, and 2012, and reconstruct the data of international trade and domestic trade for each province in the provincial SRIO tables using the customs data. We then use the method of minimizing cross entropy and gravity model to estimate interprovincial trade flows based on the railway transportation data of goods, as well as several other datasets. With all these information, based on the Chenery-Moses model, we finally build a multi-year MRIO database of the mainland China covering 30 provinces (except for Tibet due to data limitation) and 33 sectors. We also analyze the characteristics of Chinese provincial economy from 1992 to 2012 by multipliers based on the MRIO database we build. This database provides a consistent and complete foundation of the provincial data for studies about China's economy-related issues.

Misallocation and China's regional disparity: Theory and evidence

Topic: China's (Inter)provincial Input- Output Tables: Applications and Advances
Author: Jiansuo Pei

One of the fundamental questions faced by academia and policy-makers is why some regions grow faster than others. In China's context, the regional disparity has been tackled by the central government, but far from resolved yet. Is resource misallocation an important determinant of regional disparity? Following Jones (2008), we first analyze the relationship between resource misallocation and total factor productivity and show that misallocation of resources tend to reduce income level in theory. Second, we construct a neoclassical growth model featuring intermediate goods with N sectors, illustrating the importance of the intermediate goods input in determining the output multiplier, which in turn affect the regional income disparity. Then, we show that the tax rate level (distortion) and its volatility have a negative correlation with income. Finally, China's input-output data of 31 provinces are used to empirically assess the extent that resource misallocation on regional disparity.

We find a strong positive correlation between regional multipliers and regional per-capita income, and also find that the input-output structure between regions has certain similarity. Furthermore, in order to quantitatively examine the effects of resource misallocation stemmed from intermediate inputs and various distortions (i.e., tax rates), we simulated corresponding parameters of other regions with that of Shanghai (the benchmark region, or the frontier). It is shown that, large room remains for most regions to improve resource allocation efficiency, as the incomes would have increased given that they were benchmarked to Shanghai. In addition, the relatively under-developed regions would experience higher growth rate, indicating that these regions suffered more serious resource misallocation. This study clearly enhances our knowledge on the fundamental role of intermediate inputs played in affecting output mulitplier which in turn determining the regional income levels.

Sectoral effects of discrimination on labour input allocation

Topic: Gender issues in IO models (II)
Author: Yolanda Pena-Boquete

CGE models have incorporated gender features since 2000 mainly by disaggregating labour factors by sex. Additionally, in recent years some authors have also included unpaid household work and have accounted by the interactions between market and non-market activities. Other features that may be very relevant in the gender-aware CGE, but that have not been incorporated yet, are the labour inefficiencies. Labour market inefficiencies such as discrimination have been very studied both in the labour and gender literatures, but have not been considered in CGE modeling. The omission of these features may bias the simulation results of policy evaluation. Thus, the aim of this paper is to do an exploratory analysis of the effects of discrimination on labour input allocation, with a view to incorporate them in future gender-aware GCE models. This paper contributes to the literature in being the first paper analysing the effect of wage discrimination or unexplained gaps on labour input allocation. Additionally, we analyse the sectoral differences of these effects depending on factor elasticities of substitution and labour intensities. Using yearly data for Spain between 2005 and 2013, the paper estimates constant elasticity of substitution production function (CES) by sector that incorporates male and female labour inputs, a non-labour input and a productivity parameter. The model is estimated by two stage least squares (2SLS) with cross-equation restrictions for each sector.

Trade Integration and income inequality in Brazil: a general Equilibrium approach

Topic: Global Flow of Funds Data and its Applications
Author: Fernando Salgueiro Perobelli
Co-Authors: Edson Paulo Domingues, Vinicius A. VALE

This study aims to evaluate the effects of the trade integration between Brazil and the European Union and Brazil and the United States. In order to complement similar studies, this research proposes, besides to the effects on macroeconomic and sectoral indicators, an evaluation of the effects on the income structure of ten representative households in Brazil. We have used a global-national integrated Computable General Equilibrium (CGE) model, the BR-TAM (Brazilian Trade Analysis Model). This model has been calibrated based on the use and integration of two other CGE models, the global model – GTAP (Global Trade Analysis Project) and the national one – ORANIG-BR (Computable General Equilibrium Model of a Single Country of the Brazilian Economy). The BR-TAM model considers the trade relations among the regions and the sectoral linkages of the Brazilian economy. In addition, it maps the generation and appropriation of income, as well as its use, by the extension in the national module that incorporates multiple households and income flows from the Social Accounting Matrix (MCS) estimated based on preliminary data from the Input-Output Matrix (MIP) for 2011 of The University of Sao Paulo Regional and Urban Economics Lab (NEREUS), from the Integrated Economic Accounts (CEI) and from the Household Budgets Survey (POF) of Brazilian Institute of Geography and Statistics (IBGE). The effects of the two integration scenarios, although presenting some similarities, generally point to diverse trade-offs in relation to activity level, employment, and sectoral production. Different activities are potentiated in each of them. Moreover, different pressures are exerted on the income structure and, consequently, on Brazilian income inequality and concentration. In this way, this study contributes to the literature and trade agenda through a prospective study able to orient a short and medium-term integration strategy, since it brings some potential effects on macroeconomic and sectoral variables, and on income structure of heterogeneous household in Brazil.

Value added-based carbon responsibility: added value as allocation criteria for GHG emissions in comparison to existing full and shared responsibility approaches

Topic: IO modeling: Consumption-based accounting
Author: Pablo Pinero
Co-Authors: Martin BRUCKNER, Stefan Giljum, Hanspeter Wieland

Several approaches to allocate environmental responsibility along international supply chains have been introduced in the input-output literature, in particular related to the issue of greenhouse gas (GHG) emissions. This paper adds a new approach to this debate: value added-based carbon responsibility. This approach allocates total GHG emissions occurring along a global supply chain to industries and countries according to the share of total value added which is created within that specific supply chain. The calculation method is relatively simple and easily replicable: value added-based carbon responsibility is obtained post-multiplying the consumption-based carbon footprint by the value added multipliers matrix, i.e. by the product of the sectoral value added vector and the Leontief inverse. However, value added is as well employed as environmental responsibility allocation criteria in other approaches, such as the shared producer and consumer responsibility, the beneficiary-based shared responsibility, or the

income downstream responsibility. While the reasons for using value added are in theory very similar in all cases (e.g. as a proxy of actor's control over the supply chain or share of generated benefits), these approaches differ in important methodological aspects, such as the allocation direction (upstream vs. downstream) or the fraction of environmental responsibility which each actor receives. In this article, we investigate the differences between the value added responsibility and other allocation methods using GHG emissions as common environmental indicator. The empirical assessment is performed employing EXIOBASE 3, a global multi-regional input-output database covering the global economy separated into 44 individual countries and 5 country groups. Our results suggest that the value added-based approach levies significantly higher or lower responsibility for certain countries and industries in comparison to other perspectives. Our approach thus contributes to the debate on how to share the global costs of climate change mitigation and adaptation.

Measuring the contribution of nuclear energy to reducing greenhouse gas emissions – case of Poland

Topic: Thematic IO analysis: Energy and Environment
Author: Mariusz Plich

Securing sustainable, low-cost energy supplies with minimal impact on the environment is common interest of every country. For these reasons in the forthcoming decades a significant limitation of coal share in power generation mix should be expected in Poland , in favor of nuclear energy and renewable energy sources. Although the construction of a nuclear power plant in Poland has been widely discussed since the 1970s, it has not been built yet. At the end of last year, the government announced a plan of the development of nuclear energy. An impact of this plan on the economy as well as the reduction of CO2 emission in Poland is assessed in this paper. For the assessment a multisectoral macroeconomic model and scenario analyses are used.

To meet this goal two problems has to be solved: (1) inclusion of new technology to the existing structure of input-output and emission coefficients and (2) development of scenarios for the future power generation mix based on the analyses of possible future demand for electricity as well as electricity supply by technology.

The data used in the research include international databases, i.e. WIOD (input-output tables, socio-economic accounts and environmental accounts) and Eurostat database (input output tables, energy statistics) as well as domestic sources published by Statistics Poland and Energy Market Agency SA.

The novelty of the research can be considered in the following areas:
(1) energy policy - the first attempt to assess new plans of Polish government with the use of multisectoral macroeconomic model
(2) methodology - proposal of "translation" of power generation mix by (by technology) into the language of nput-output coefficients
(3) practice of modelling - construction of a generic model and software which can be used for any country for analyses of changes in energy mix.

Conceptual differences between macro-econometric and CGE models

Topic: Input-output and sectoral macro-econometric modelling: Part of the same family
Author: Hector B. POLLITT

Conceptual differences between macro-econometric and CGE models
This paper discusses the main similarities and differences between macro-econometric and Computable General Equilibrium models. It shows that, while both types of models are based on a core input-output and national accounting framework, differences in the underlying behavioural assumptions mean that the direction of causation of many of the key flows in the model is reversed.
The discussion of differences in approach starts with the key assumption about how uncertainty is treated in the models. We show that if the existence of fundamental uncertainty is accepted, it becomes impossible for agents to optimise decision making by maximising expected utility and hence an alternative approach to modelling behaviour is required. In the absence of optimisation, the properties of the modelling system change substantially, with the level of output determined by demand-side factors rather than the most efficient use of the available factors of production, given a production function and factor prices.
We then move to the critical discussion of how the financial sector is treated, which is increasingly noted as an important difference in approach. We note that, within each modelling approach, there is consistency between treatment of the real economy and financial sectors, with the CGE approach allocating a fixed supply of money optimally, and the macro-econometric model assessing the demand for money.
Throughout the discussion, the models' theoretical and structural assumptions will be compared against the relevant strands of macroeconomic theory.
We conclude with a summary of key characteristics and assumptions that is designed to help policy makers and the other users of model results to interpret the findings from models.

For organised session: Input-output and sectoral macro-econometric modelling: Part of the same family (Organiser Hector Pollitt)

Projections of consumption-based emissions for the EU and globally

Topic: IO modeling: Consumption-based accounting
Author: Hector B. POLLITT
Co-Authors: Eva S. ALEXANDRI

In recent years, researchers have used multi-regional input-output (MRIO) analysis to estimate the carbon dioxide emissions linked to a country's consumption, sometimes referred to as the 'carbon footprint'. These consumption-based indicators have complemented the more standard production measure of production-based emissions that is reported in national inventories. In this paper we use the same approach to provide projections of consumption-based emissions out to 2050.

To carry out the projections, we use the E3ME macro-econometric model and link it to an MRIO framework that is based on the model's own data. We apply this combined tool to three different scenarios of future climate policy in which first the EU and then the rest of the world implement measures to meet global carbon targets. We estimate emissions in each case on a consumption

basis and also on a technology-adjusted consumption basis, drawing on the recent literature.

After assessing historical trends in our modelling framework, we present forward-looking results for the EU, the US and China in terms of absolute levels of emissions and 'net trade' in emissions. We find that there may be substantial differences between both current levels and future trends in consumption-based and technology-adjusted consumption-based emissions. This leads to a discussion of how best to measure national carbon footprints in a world where the pace of decarbonisation varies substantially between countries.

Structural changes in Russian agriculture and its impact on the economy

Topic: Classical IO applications: Industrial economics, Productivity and Efficiency
Author: Dmitry Polzikov

In 2000-2015 Russian agriculture grew, adding an average of 2.3% per year (+ 40% over the entire period). This growth was driven by socio-economic development of the country and government support of agriculture. It was accompanied by the following large-scale structural changes.

Firstly, the structure of domestic final demand for food was changing. As incomes of the population in Russia grew, domestic consumption of more expensive products (such as meat, vegetables, fruits, eggs) increased.

Secondly, due to government support of agriculture, imported food was being replaced. In particular, the share of imports in domestic consumption of meat decreased from 31% in 2000 to 13% in 2015, the share of imports of sugar decreased from 67% to 20%.

Thirdly, as a result of the technological modernization of Russian livestock, its productivity has sharply increased. For example, in pork production, feed consumption per animal unit decreased by 3 times over the period 2000-2015. Intermediate consumption of grains for feed purposes increased by a quarter, while output in livestock increased by 40%.

Fourthly, the technological level in Russian crop production has increased. The yield of grains and oilseeds increased 1.5 times. The average grain harvest in 5 years increased 1.4 times, oilseeds - 3.3 times. Due to this, against the background of stable domestic demand, the volume of grain exports increased during the period 2000-2015 from 1 million tons to 31 million tons (up to 30% of domestic production). Exports of oilseeds (including exports of vegetable oils) increased 3.5 times up to 45-50% of domestic production. Thus, the growth of exports has become an important direction for the development of Russian agriculture.

These shifts led to changes in the agricultural production structure (the share of meat, grain and oilseeds increased, while the share of milk, feed crops and potatoes decreased), and in the proportions between final and intermediate consumption of agricultural products. Exports increased significantly and imports of food and agricultural raw materials decreased.

The development of agriculture had a significant impact on the growth dynamics of the Russian economy. The contribution of agriculture to GDP growth for the period 2000-2015 amounted to 6%. The same contribution was made by food production. The use of Input-Output approach allows us to take into account not only direct, but also indirect effects of agriculture development. On the basis of the Input-Output tables for Russia developed by the Institute of economic forecasting of the Russian academy of sciences, output multipliers were calculated, which show how gross output grows due to initial increase in output of the sector under consideration. When calculating them, both indirect effects (output growth in related sectors) and induced effects (additional growth in final demand from households, government, and business due to generation of additional income) were taken into account. The results of calculations obtained using these

multipliers show that the impact of the increase in the output of agriculture and food production was about 2 times greater than the estimates of the direct contribution to the increase in gross output. This means that the collective contribution of agriculture and food production to GDP growth in 2000-2015 can be estimated at about 25-30%.

(1)   The study is aimed to describe the development processes of the Russian agriculture with a focus on structural shifts (including shifts in the production structure, technologies, foreign trade and final demand) during the period 2000-2015. Using national Input-Output tables developed by the Institute of economic forecasting of the Russian academy of sciences, we assess the macroeconomic impact of these structural shifts on the Russian economy.
(2)   To assess the impact of Russian agriculture development on the economic dynamics, an Input-Output approach is used.
(3)   The national Input-Output tables developed by the Institute of economic forecasting of the Russian academy of sciences are used.
(4)   The novelty of the research is in applying an Input-Output approach to assess the impact of retrospective agriculture development on the Russian economy.

Forecasting inflation using input-output model. Sources of errors.

Topic: IO Theory: Input-Output Price Model
Author: Michał Przybyliński
Co-Authors: Artur Gorzałczyński

(1) the research question
The presented considerations are an attempt to verify the possibility of using input-output tables for modeling and, as a consequence, forecasting inflation. The conclusions help to understand the price formation mechanisms, especially exchange rate pass-through.
(2) the method used
The study consists in an attempt to reproduce the historical values of the commonly used HICP index by on the input-output price model. The procedure involves ex post solution of input-output price model for an open economy, and then applying appropriate weights to calculate a macroeconomic deflator of household consumption. In the experiment it was assumed, that the exogenous variables of the price model (unit value added and prices of imports) have been perfectly forseen, and the parameters of the model were adopted at the level of the base year. Forecasts errors were decomposed into three components. These are:
1)   change in parameters of the price model
2)   the specificity of household expenses
3)   differences in the HICP estimation method and household consumption deflator.
(3) the data used
The procedure was described, sources of errors were also indicated and their scale was assessed using the data for the Danish economy. Statistics Denmark provides input-output tables distinguishing 117 sectors of the economy and covering the years 1966 - 2014, expressed separately in current and previous year prices.
(4) the novelty of the research.
The proposed procedure is significantly different from the most frequently used methods of forecasting inflation, which describe the macroeconomic price indicators (with higher than annual frequency) using stochastic models. A precise description of the price formation process is crucial for decisions made by central banks, which is why the most intense work is mainly focused on studying the pass-through mechanisms of exchange rate fluctuations on domestic prices. Input-output models create more opportunities to conduct analyzes taking into account price

changes in individual markets. Their advantages are: clearly defined cost formula, high detail and simple construction. That's why i-o price models also serve as tools for investigating price transmission mechanisms. This time these mechanisms are analysed as forecast errors.

Integrating natural capital into CGE modelling

Topic: IO modeling: Computable General Equilibrium Modeling and Social Accounting Matrices
Author: Yang Qu
Co-Authors: Melanie Clare Austen, Tara Hooper, Eleni Papathanasopoulou, Xiaoyu Yan

An increased emphasis on the valuation of natural capital has led to the need for incorporating natural capital accounts into economic modelling. The valuation estimates aim to raise awareness of the economic significance of natural capital and better inform policy making. Computable General Equilibrium (CGE) models have recently been used to link natural capital to the whole economy since CGE models can incorporate monetised natural capital in a quantitative and consistent framework.

The rapid development in offshore wind energy industry over the last decade has raised concerns on its environmental and socioeconomic impacts on the fishery industry and the wider economy. Both offshore wind and fish are two important types of natural capital provided by the marine environment. CGE models can be used to assess the impacts of one industry on the other based on their interactions with each other and the wider economy. Both fishery and offshore wind are important industries in Scotland, where fishery is commercially important to the economy while the offshore wind industry is under rapid development. We have developed a static CGE model for Scotland, with an environmental extension in marine natural capital, using the 2009 Scottish Social Accounting Matrix (SAM) data. The model assumes disaggregated marine natural capital as a production factor competitively used by the energy sector and fishery-related sectors. An established fish harvest function is used to connect the fishery industry to natural capital within the CGE model structure in order to simulate potential shocks on the fish stock or fishing effort. A case study is used to evaluate the impact of offshore wind on fish stock changes in the context of natural capital and economic performance, the impact of economic changes on the production of fish, and the feedbacks between them. This modelling approach provides an illustration of the potential for incorporating natural capital into CGE models in practice.

How can an input-output model support local environmental policy? Opportunities, limitations and challenges

Topic: IO's role in covering environmental policy needs
Author: Willem Raes

Historically environmental policy was mainly focused on local problems, e.g. oil spills, polluted streams, air pollution by a factory... These problems could be looked at from a territorial perspective only. However, the current environmental challenges are often global. Nevertheless, the focus of most policies remains unchanged. How can we reduce the greenhouse gas emissions within our borders? How can we improve the resource efficiency of our businesses?

It is necessary for local environmental policy to adapt to global challenges, like climate change and resource scarcity. The Public Waste Agency of Flanders (OVAM) and the Flanders Environment Agency (VMM) commissioned VITO and the Federal Planning Bureau to develop the Flemish environmentally extended input-output model (EE-IO model) embed in the EXIOBASE

IO-model. This multi-regional EE-IO model started to widen the scope of the Flemish policy to a consumer or footprint perspective. How can we reduce the impact of the Flemish consumption on climate change and raw material extraction?

A better understanding of the carbon and material footprint of Flemish consumption is important when deciding on policy actions to enhance consumer and producer behaviour. Together with VITO, OVAM is currently using the EE-IO model to better understand and measure the global and local effects of circular economy strategies. What does a circular economy mean for Flanders and what are the effects on Flanders and worldwide?

However, the development of the EE-IO model is challenging and the model has its limitations. The presentation will start with a few cases where the EE-IO model calculations are used in policy-making. In the second part, expectations and possible limitations of IO models will be brought up. The session will end with a discussion on whether these challenges can be met by developers of IO models.

Title special session: IO's role in covering environmental policy needs.

The Eurostat's balanced view of trade in services

Topic: Want to know more about how the EU FIGARO ICIO tables were made?
Author: Isabelle REMOND-TIEDREZ
Co-Authors: Juan Manuel Valderas Jaramillo

Asymmetries due to the mismatching in the data provided by one country and the mirror flow provided by its partner country for the same transactions are an important issue in trade statistics, especially when it comes to link all European Union (EU) economies as in the FIGARO dataset.
Although at EU level, balance of payments statisticians and trade in services statisticians follow up regularly on the asymmetries and try to reduce them, we needed to implement a methodology for compiling a balanced view of trade in services as an input to the EU inter-country supply, use and input-output tables.
For the first release of FIGARO tables for the year 2010, the 2010 international trade in services data (ITSS) serves as the primary input. Their exports and imports (or mirror exports) are subsequently cleaned, imputed, estimated, modelled and confronted with Balance of Payments data to get a full dataset for 29 countries (EU Member States plus USA), 30 partner countries (plus RoW) and a number of services items. The balancing of the resulting exports and import values to solve the bilateral trade asymmetries is based on the methodology developed by the European Commission and the OECD (Martins Ferreira, 2018). As the EU inter-country supply, use and input-output tables present economies using the activity and product classification, the last step is to bridge the balanced trade view of the data from services categories to product classification (CPA/CPC).
The paper summarises the steps as compiled for the 2010 tables and shows the way foreseen to improve the compilation steps for the time series 2010-2016. We also evaluate the impact on the original input data of each of the steps involved.

Martins Ferreira, P. (2018) "The QDR methodology: understanding trade flows in the EU", EURONA, issue N°2/2018, pp. 55-70.

Investments in wind energy in the State of Bahia: an analysis using input-output indicators

Topic: Thematic IO analysis: Social and Socio-Economic Analysis
Author: Carolina SILVA RIBEIRO
Co-Authors: Gilca Garcia de Oliveira, Roberto Maximiano Pereira

The Brazilian electricity matrix is mainly based on renewable energy sources. In the year 2017, the growth of sources of electric power generation was led by hydroelectric and wind power sources. The states of the Northeast are the most representative in wind generation. In 2017, the five states with the largest generation were Rio Grande do Norte, Bahia, Rio Grande do Sul, Ceará and Piauí, respectively. The state of Bahia occupies a prominent role in the national scenario due to its significant potential for wind power generation. In Bahia, more than 30% of the energy produced is wind energy. The implementation of renewable sources, such as wind power, is characterized as a development potential for the State. In this sense, it is questioned which sectors have the greatest capacity to promote the regional development from the investments in the wind power source? Thus, this work seeks to evaluate the impacts of investments in the wind power chain in Bahia, aiming to provide information on the sector for economic agents. To do so, it uses the input-output matrix estimated by the Superintendency of Economic and Social Studies of Bahia (SEI) for the year 2015. The analysis will be based on a study of the sectors of economic activities of the State, as well as the investments made in the wind sector, using traditional input-output indicators (key sector, analysis of employment, income and output multipliers) in order to investigate job creation and the economic production associated with the wind energy production chain. The results of this article will allow a better understanding of the role of wind energy in Bahia.

Assessing productive structures in Brazil with dynamic input–output networks

Topic: IO modeling: Conjoined Modeling Approaches
Author: Luiz Carlos de Santana Ribeiro
Co-Authors: Hernane Borges de Barros Pereira, EDER Area Leão PEREIRA, Roberto Luiz Souza Monteiro

Econophysics is the use of complex systems in economic studies (Carbonne et al., 2007; Jovanovic and Schinckus, 2017; Mantegna and Stanley, 1999; Pereira et al., 2017; Schinckus, 2013). It is an approach that has advanced both the identification of economic problems and attempts to solve them. According to Pereira et al. (2017), network theory is among the subareas that have contributed to econophysics. Schweitzer et al. (2009) defined the importance of network theory to the economy, since in networks, it is possible to study properties such as time and space, structure identification, and systemic feedback, providing a novel approach to assessing the productive structure of countries or regions.

The seminal study of network theory and production was conducted by Solow (1952), who analyzed aggregate fluctuations. Bak et al. (1993) later showed the importance of inputs and the supply chain in diffusing shocks between aggregate sectors. In the last two decades, interest in network theory and improvements in computation have enabled the development of several network analysis methods and the discovery of new network properties.

In the input–output (IO) field, a recent advance that has allowed hypotheses to be more flexible and has reinforced results is integration with other models, such as linear programming (Hristu-Varsakelis et al., 2012; San Cristóbal, 2012; Souza et al., 2016), econometric models (Kim

et al., 2015; Kratena and Temursho, 2017) and complex networks (Carvalho and Gabaix, 2013; Cerina et al., 2015; Tsekeris, 2017). Specifically, Acemoglu et al. (2012) and Carvalho (2010) have used network theory to analyze the problem of aggregate fluctuations in macroeconomics. Cerina et al. (2015), using a world IO database, analyzed the inter-industry relations of several countries through calculations of PageRank centrality and community coreness. In addition, Río-Chanona et al. (2017) evaluated trade relations among 40 economies, and found a strong correlation between the three major economies (United States, China and Germany), indicating a high centrality between trade relations.

Recent research involving trade relations between several countries has used networks that emphasize the role of centrality (Blöchl et al., 2011; Xing et al., 2017) and country-specific assessments (He et al., 2017; Tsekeris, 2017; Xu et al., 2011). It is important to highlight that other studies have also analyzed production, but not necessarily using IO matrices (Atalay et al., 2011; Hidalgo and Hausmann, 2009; Ohnishi et al., 2010; Xiao et al., 2017).

Integrating IO models into network theory is even more interesting when applied to complex productive structures, as seen in Brazil. Moreover, results improved considerably if the database used covers a long period of time, because it can account for important factors, such as structural and governmental changes. However, this type of approach has rarely been applied to the Brazilian economy. This study intends to develop an analysis of dynamic IO networks to evaluate the evolution of the Brazilian productive structure, considering the varying sector relationships over time. As far of our knowledge, this type of approach has never been applied before. Thus, it is possible to measure the impacts of economic events such as financial crises or macroeconomic policies on the properties of the networks or the interconnection between economic sectors. For this, we use a network analysis of Brazilian IO matrices from the World Input–Output Database for the period 1995–2011.

The main contributions of this paper are: (i) a novel method for evaluating productive structures; (ii) an assessment of the macroeconomic policies introduced by different governments over time; and (iii) a contextualized analysis of strongly linked sectors. All of these topics could be generalized to any other country.

Hard-linking Energy and Economy models based on a Dynamic Input-Output framework

Topic: IO modeling: Conjoined Modeling Approaches
Author: Matteo Vincenzo Rocco

Power sectors are recognized as pivotal in meeting long-term national environmental targets. For this reason, it is fundamental to develop methods and models able to comprehensively assess the economy-wide implications due to implementation of new energy technologies or energy policies.

The scope of bottom-up models is usually limited to the national power sector, by determining its power output on an hourly basis with high technology disaggregation, or by planning optimal future capacity investments. However, these models are unable to capture the linkages between the power sector and other sectors of the economy. On the other hand, top-down macroeconomic models provide a comprehensive picture of the economy, but they suffer from high space and time aggregation, being unable to represent the behavior of power technologies with high temporal detail. Several attempts to link bottom-up and top-down models can be found in the literature: despite this, a fully dynamic, integrated energy-economy model is still lacking.

In this paper, the Duchin's Rectangular Choice of Technology model (RCOT) is reformulated based on a Dynamic input-output framework: technical coefficients and final demand of electricity (per hour) and of other products (per year) are exogenously provided to the model, which

endogenously returns the optimal power production mix by energy technology and consumption by sector on an hourly basis, in order to meet a set of given technical and economic constraints. The model is applied to Italy in 2011 as case study, based on data retrieved from Exiobase v.3, International Energy Agency and by the Italian electricity distribution institution.

Results of the case study reveal that the proposed approach may be suited for investigating several research issues, by comprehensively considering the linkages among all the national productive sectors (e.g. technologies integration, economic policies, competition for natural resources, etc.).

Evaluating the Role of Resilience in Reducing Economic Losses from Disasters: A Multi-Regional Analysis of a Seaport Disruption

Topic: Thematic IO analysis: Disaster and Adaptation
Author: Adam Rose

Models to estimate economic impacts of disasters have recently been augmented to include resilience. However, most research to date has incorporated only a limited set of resilience tactics and has not estimated their individual effect on reducing losses. We present a comprehensive framework for decomposing the effects of a broad set of post-disaster resilience tactics. Our methodological innovation is illustrated by adapting the TERM Multi-Regional CGE Model in the case of a seaport disruption, distinguishing inherent resilience working through the price system from primarily adaptive resilience tactics to cope with input shortages. We also overcome a path-dependency problem in the modeling process.

Estimating Induced Effects in IO Impact Analysis: Variation in the Methods for Calculating the Type II Leontief Multipliers

Topic: New techniques, constructions and applications of Social Accounting Matrices
Author: Andrew G Ross
Co-Authors: Tobias Emonts-Holley, Kim Swales

This paper compares and evaluates existing methods for calculating Type II Input-Output (IO) multipliers. These methods are alternative formulations of the standard Leontief multiplier model that claim to endogenise household consumption. We find that all the methods have drawbacks because the IO accounts are missing key data required to correctly link household income and consumption to domestic economic activity. However, Social Accounting Matrices (SAMs) incorporate, and systematically track, the flow of factor incomes to households that IO analysis lacks. We therefore compare the values for various IO Type II and SAM multipliers, using comparable regional (Scottish) and national (UK) data sets. The results suggest that variation in Type II IO multiplier values is an empirically non-trivial issue and that practitioners should be aware of this.

Traceability of the assumptions made in the construction of the EU inter-country supply, use and input-output tables

Topic: Want to know more about how the EU FIGARO ICIO tables were made?
Author: José M. RUEDA-CANTUCHE
Co-Authors: AGUSTIN VELAZQUEZ-AFONSO, Isabelle REMOND-TIEDREZ

The modular approach adopted in the construction of the EU inter-country supply, use and input-output tables (Figaro project) to map the different adjustments and imputations made to the original data allows each adjustment/imputation to be measured at the different stages of the compilation process. As a result, this paper provides summary statistics based on:
• the comparison between the international merchandise and services trade data adjusted for goods sent abroad for processing and merchanting activities and the trade values in the national available SUTs (i.e. discrepancies);
• the analysis of the row and column total discrepancies by countries, users and products;
• the analysis of the final balancing adjustments made to estimate the inter-country use table without discrepancies, by countries, users and products.
This analysis provides useful information for the user of the FIGARO tables and helps producers in: highlighting the importance of the scope of some of the statistics they produce; identifying what type of data is still missing from national statistical offices; and identifying where to put more efforts in future revisions. All these aspects are relevant for the compilation process.

Can confidence intervals for input-output multipliers be estimated with supply and use tables?

Topic: IO modeling: Data choices for IO models
Author: José M. RUEDA-CANTUCHE
Co-Authors: Robert STEHRER, Antonio F. AMORES, David Zenz

The Leontief quantity model generally provides point estimates of the output multipliers due to changes in final demand. The model could even be expressed for other variables such as value added, employment and environmental pressures. In doing this, input-output tables are required, typically with the same number of industries and products. This paper proves however that the Supply-Use based approach (SUBE) is able to provide confidence intervals to such multipliers using Supply and Use Tables and therefore, a different number of industries and products. Our empirical work is broadly supported by the WIOD database and by the use of panel data econometrics.
The SUBE approach therefore opens up the door to the estimation of confidence intervals and hypotheses tests of the standard backward input-output multipliers. We prove this statement in our paper given the negligible but statistically significant bias of the results compared with the Leontief inverse approach and using, as a novelty, panel econometrics. In the future, the SUBE approach should be seen as complementary to the classical Leontief input-output model to do standard input-output analysis with uncertainty measures for backward multipliers of any type, i.e. output, employment and value added, for instance.

NAFTA EFFECTS ON CANADA, MEXICO AND THE UNITED STATES: A MUTIREGIONAL INPUT-OUTPUT ANALYSIS II

Topic: Classical IO applications: Trade and GVCs
Author: Pablo RUIZ NAPOLES
Co-Authors: Eduardo MORENO REYES

Abstract

The North American Free Trade Agreement NAFTA has been changed into USMCA after 23 years of duration and one year of renegotiation. The main reason for modifying the agreement was put forward by the US president Trump's administration as its being unfair to the US, because of US companies established plants to produce and export in Mexico, generating for Mexico a trade surplus which translates into a US trade deficit, the third largest in US trade statistics. This has been said to damage also the domestic level of employment in US manufacturing sectors. However, a precise measure of this supposed "damage" to US labor caused by Mexican exports is still missing, nor is it clear how many and what sectors have been damaged.

On the other hand, some developments in Multi-Regional Input-Output Analysis (MRIO) allowed some experts to produce a study for the European Community, published in 2015. We intend here to do a similar study for NAFTA.

Our study is aimed to answering two basic questions: (1) which were the results positive or negative, of the operation of NAFTA for each of the three economies involved ? (2) what sectors in each economy were most benefited or damaged by NAFTA in each of the three economies? Thus, the objective of this particular study is to build and use a Multiregional Input-Output model for the North American region: Canada, Mexico and the US, to determine the effects of NAFTA for trade, income, output and labor in each of the three economies.

Development of SME-SAM for Analysis of Income Distribution in Malaysia

Topic: IO modeling: Computable General Equilibrium Modeling and Social Accounting Matrices
Author: M. Yusof SAARI
Co-Authors: Chakrin UTIT

Small and Medium Enterprises (SMEs) are observed to be an important sources for income generation, employment growth and income distribution in developing countries. Recent development of inter-industry model for income distribution analysis is unable to deal with dualistic aspects of production structures between SMEs and large sectors. Failing to recognize the dualistic production structures in the inter-industry models implying that homogeneity assumption in the macroeconomic models cannot be avoided. In particular, one might get a false impression that growth in some sectors will "trickle down" equally to benefit all sectors regardless the sizes. This paper aims to develop a unique database so-called Malaysian SME-Social Accounting Matrix (SME-SAM) that captures inter-industry linkages between SMEs and large sectors, and income distribution. In our SME-SAM, a sector is separated into small, medium and large sized sectors. In addition, labor and household are further disaggregated into several income classes by ethnic groups. Database from input-output table, economic census, household income and expenditure survey, and other sources are used to construct the SME-SAM for Malaysia. Based on this unique dataset, several analyses that specifically address the income

distribution issue in Malaysia will be performed. For example, analyses are able to measure the extent to which the level of interdependencies between SMEs and large sectors is important in explaining the level of income distribution across income classes in Malaysia.

Reshaping global production: knowledge-intensive activities as drivers of structural change in the post-2008 crisis

Topic: Classical IO applications: Economic Structural Change and Dynamics
Author: Marianela SARABIA

Focusing in the post-2008 crisis period, this article contributes, first, to analyse the missing link between the global trade slowdown and changes in global production by redefining the concept of 'global production system' (GPS). Under this framework and according to recent studies, we identified changing growth patterns between developed and emerging economies as well as compensation effects in terms of job creation and business activities specialization, with a knowledge-intensive biased towards developed economies. Indeed, we found that, behind global structural change, two main phenomena are acting -or likely to act- as the main drivers of international business relocation towards advanced economies since mid-2000: 1) a short-term reversal due to misjudgement correction of initial offshoring decision; and 2) the centrality of knowledge economy led by requirements of technological change embodied in newer production technologies.

Based mainly on the latest, it is possible to state that there is an emerging accumulation pattern led by knowledge-intensive capabilities and its development, which, being mainly concentrated in advanced economies, seems to be behind on-going reconfiguration of the GPS. Based on national input-output tables from WIOD latest version, this article, then, presents an empirical corroboration. To do so, it takes in consideration two groups of countries in which developed economies are represented by Canada, France, Germany, Italy, Japan, the UK and the USA (G7 members) and emerging economies are represented by Brazil, Russia, India, China (BRIC countries). In order to test the main hypothesis, existing taxonomies for activities classification nurtured by complementary literature review allows adopting the following criterium for sectoral breakdowns: knowledge-intensive, medium-tech or low-tech. Additionally, input-output methodologies are applied for measuring structural change in the two countries' groups between early-2000 and 2014.

We conclude that developed economies have strengthened their specialization pattern in knowledge-intensive activities since early-2000s, whereas emerging economies have been growing in medium-tech and low-tech activities. Since these activities are related to a lower share of value added/gross output in comparison with the analogous coefficient for knowledge-intensive activities, current academic debate and global agenda should discuss issues related to international division of labour and its implications in order to contribute to a more comprehensive analysis for sustainable development. In this sense, a key question for further research is how far specialization in medium- or low-tech activities is likely to affect local capabilities for creating and scaling up complex technologies -rather than just adopting or using- without deepening polarization between advanced and emerging -or developing- economies as well as within them.

Alternatively, it may be considered for:
• Classical IO applications (1), Economic Structural Change and Dynamics or
• Thematic IO analysis (9) Technology/Innovation

Economic structure and gender inequality: a global perspective

Topic: Gender issues in IO models (I)
Author: Cristina Sarasa
Co-Authors: Rosa DUARTE, Mònica SERRANO

The evolution of the participation of women in labour markets notably differs by country, and greater female participation rates have not always resulted in significant advances in gender equity in all countries. Economic and social indicators tell us about the persistence of gender employment gap, which accounts for differences in participation in the labour market between women and men. In this context, the objective of this work is to analyse the impact of economic growth, and structural and technological change on the evolution of gender inequality across the world. The temporal analysis ranges from 1990 to 2015, a long and interesting period regarding the processes of globalization and structural change worldwide. Using the information provided by EORA database, the changes in the economic structure of countries and world regions are analysed, with a focus on the implications for labour demands and gender gaps. Specifically, using a global multisectoral and multi-regional input-output model, disaggregated to 26 economic sectors, the sectoral linkages in each region are taken into account in order to obtain information of the main sectors in each country that contribute to gender inequality. To do it, we first explore employment patterns by gender both in 1990 and 2015, together with gender gaps by sector and country. We then address a Structural Decomposition Analysis to obtain additional indicators related to feminization indices of the economy by sector and country. Finally, on the basis of the previous findings, and taking advantage on the multisectoral and multiregional character of our database, a regression analysis is used to account for the role of trade openness and evolution, industry specialization and additional country indicators such as culture and religion on the gender inequality.

Consumption based emission accounts - recommended approaches for modelling energy and emissions embodied in trade

Topic: IO Data for environmental and social analyses
Author: Sarah Schmidt
Co-Authors: Kirsten S. WIEBE, Richard WOOD

Increasing focus is being placed on consumption based accounting of greenhouse gas emissions, or carbon footprints. As policy is being developed alongside these measures, there is a clear need for robustness in the footprint accounts and calculations. Whilst consumption based accounting needs information on supply chains and consumption, such as through multi-regional input-output (MRIO) models, a critical area to get consistency between models is on the emissions accounts themselves.

Due to construction challenges in MRIO, incomplete data, and lack of resources in following relevant accounting standards, estimation steps are required and accounting practices are not uniform, thus leading to the inconsistency among MRIO databases, in particular for carbon footprint results. Recent work has shown that of the main components of environmentally extended MRIO databases – i.e. the inter-industry flow matrix, the final demand account, and the environmental stressor account – it is the latter, the environmental accounts, which are the single biggest contributor to variance across the models.

In this work, the goal is to exemplify the principal approaches in establishing energy use and greenhouse gas accounts in MRIO models, to establish the impact on consumption based accounts by following differing approaches (especially focussing on the impact of different

allocation methods concerning the allocation to residents such as international transport and purchases by residents abroad and allocation between industries), and to estimate the level of harmonisation in consumption based accounts that can be achieved through harmonisation of approaches. Furthermore, we present a harmonized approach to create environmental satellite accounts across different MRIO databases.

Is Central and Eastern Europe a pollution haven within the EU? A MRIO-panel data approach

Topic: Thematic IO analysis: Energy and Environment
Author: Ana Serrano
Co-Authors: Rosa DUARTE

The enlargement of the EU towards Central and Eastern Europe started in 2004 and has represented a significant challenge for European political and economic agendas. Fifteen years later, Central and Eastern European countries have experienced a significant economic growth, mostly based upon industrial development and trade expansion, displaying a strong integration in EU global value chains. During this period, the new member states have also been notable recipients of foreign investment, even in a context of the global economic crisis.

In this paper, we aim to analyse if this process of economic and commercial integration has also triggered the externalisation of environmental pressures towards Central and Eastern Europe. Thus, our main objective is to test the existence of a pollution haven within Europe by evaluating the specialization of Central and Eastern European economies in "dirty" industries as a result of trade. To that aim, we will use multi-regional input-output (MRIO) tables from 1995 to 2011 that will allow us to quantify the environmental pressures embodied in intra-European trade, distinguishing between intermediate and final products. This approach is optimal to assess the existence of the pollution haven hypothesis (PHH) given the global fragmentation of supply chains and the importance of intermediate flows that embody large environmental pressures. As a second step, we will use a panel data model to evaluate econometrically the PHH within a trade gravity perspective.

The results of this study can offer a comprehensive vision on the environmental consequences of the integration of Central and Eastern countries in the EU. This is particularly relevant for the development of strategies and regulations that foster the co-operation within the EU towards sustainable economies and the protection of natural environments.

Who pollutes more? Gender differences in consumptions patterns

Topic: Gender issues in IO models (II)
Author: Mònica SERRANO
Co-Authors: Francisca TORO, Montserrat Guillén

Recent behavioral literature shows that we can identify differences between women and men in diverse domains in a general context, such as empathy, social preferences and reaction towards competitiveness, risk aversion, etc. Regarding the environment, recent studies propose that women have more knowledge and concern about the climate change than men. In this context, however, there is little evidence to what extend these behavioral differences between women and men have been translated into consumption actions more environmental friendly. Within this

approach, this paper evaluates different environmental footprints of consumption patterns of women and men. As a case study, we examine Spain during the period 2008-2013. Using data from Spanish input-output tables, environmental air accounts, and household expenditure surveys for the same period, the study give evidence that gender differences take a relevant and significant position according to Weighted Least Square regression.

Impact of VAT on Agriculture Sector in Indonesia: a SAM Approach

Topic: Thematic IO analysis: Sustainable Development Goals & Policy Analysis
Author: Hadi Setiawan
Co-Authors: Sofia Arie Damayanty

The Value Added Tax (VAT) is one of the main sources of tax revenue in Indonesia. Over the last few decades, VAT revenue contributed as the second largest tax revenue after income tax. The proportion of VAT revenue also continued to increase in recent years. In nominal, VAT revenue significantly increases. In 2004 VAT revenue only IDR102 trillion (USD7.1 billion), then in 2017, VAT revenue has reached IDR481 trillion (USD33.4 billion). However, the Indonesia tax ratio is one of the lowest in the region and the world. Currently, the tax revenue is one of the fiscal risks that must be mitigated by the Government, since it never reached the target in the last ten years except in 2008. One discourse being raised to increase tax revenue is to charge VAT on all goods and services, including the agriculture sector. This paper uses the latest of Indonesian social accounting matrix (SAM) multiplier model to quantify the economic impact of the imposition of VAT on the agriculture sector, which is currently being exempted from the imposition of VAT. At present, there is no one calculating the economic impact of imposing VAT on the agricultural sector in Indonesia although the value of the VAT exempted has been calculated in the tax expenditure report of Indonesia.

Questioning the Trade-off between gender disparity and industry output

Topic: Gender issues in IO models (I)
Author: Francesca SEVERINI
Co-Authors: Maurizio CIASCHINI, Rosita PRETAROLI, Claudio SOCCI

According to the European 2020 Strategy, one of the prerogative for sustainable, competitive and inclusive growth is represented by the reduction of the gender disparities. This general ideas is corroborated by several empirical studies in this field, which confirm the positive relationship between the increase in labour market participation by women and the potential macroeconomic gains. In this perspective, Italian economy is characterised by high level of unemployment rates and low level of female labour participation, which represent the challenges that the policy maker faces when implementing a gender policy. Such policy should be able to stimulate the demand of female labour, to reduce the gender disparity and advantage the general level of employment. The economic growth should follow at least in aggregate terms, however there might exist a contradictory impact in disaggregate terms on production, income generation and distribution and final demand formation.

From this perspective, in this article an efford is made to analyse the effects of a policy aimed to reduce the gender disparity and trying to disclose or exclude any trade-offs effects between stimulating female labour demand and disaggregate performances. For this purpose, a Gendered Computable General Equilibrium (CGE) model, calibrated on the Gendered Social Accounting

Matrix (SAM) for Italian economy is developed. The integration of gender features in the SAM and thus in the CGE model, represents an important aspect of this study since it allows identifying the contribution of each industry to the generation and allocation of income by gender. The policy simulation is designed to reduce the female labour cost for industries affected by "high" gender disparity. The results permit to verify how the structural conditions of the labour market by industry affects the gender policy results and the possibility to improve the reliability and effectiveness of the adopted measures.

Keywords: Female Employment, Gender Inequalities, Social policies, Social Accounting Matrix, CGE   analysis.

JEL classification: C63, C68, D57, D58, E16, E24, J16.

China's Growth Accounting

Topic: Classical IO applications: Industrial economics, Productivity and Efficiency
Author: Xuemei Shen
Co-Authors: Masaaki KUBONIWA

China's economic growth was driven largely by investment. More than 10% extraordinary economic growth declined after Lehman shock. The government tax revenue growth rate has been less than the economic growth rate from 2015. The investment growth rate also fell down to less than 10%.
Krugman(1994) mentioned technological advances have led the advanced nations been able to achieve sustained growth over the past 150 years. Young(1992) and Kim and Lau(1994) suggest growth of the Asian "tigers" , which achieved most rapid growth during 1960-1990, was input-driven with relatively low productivity. Total factor productivity (TFP) is recognized an important factor in the process of economic growth.
Relying on official data on China's capital stock and labor inputs, this paper , based on the Cobb-Douglas production function, measure the productivity for Chinese economy over the past two decades. Here the productivity gap was assumed to be caused by deferent industry levels and by deferent regions.
This paper measures the gap of the industry level productivity mostly based on the national IO table from 1992 to 2012. It also measures the regional inequality in productivity mostly based on Multi-regional input-output table (MRIO) from 2002 to 2012.Fixed and random panel data approach is employed to estimate the productivity in the industry level and in the region level.

Keywords: China's productivity, Multi-regional input-output table (MRIO), panel data analysis

Visualizing Subjectively Weighted Lifestyle-Based Social Equity

Topic: Thematic IO analysis: Life-styles, environment and economy
Author: Yosuke SHIGETOMI
Co-Authors: Andrew John Chapman, Keisuke NANSAI, Kenichi Matsumoto, Susumu Tohno

Household consumption has the greatest effect on emissions in terms of lifecycle environmental impacts (environmental footprints) when we consider national consumption from initial raw material procurement through to final consumption. For this reason, many studies have analyzed household footprints to date, and recently, particular attention has been given to the relationship between income and environmental footprint size and the emergence of social inequality as a result. In order to address this issue, incorporating lifecycle thinking, it is necessary to undertake both quantitative assessments, in terms of environmental footprints, and qualitative assessments which consider stakeholder preferences.

In this study, we propose an input-output analysis-based sustainability evaluation framework (Chapman and Shigetomi, 2018a) which quantitatively assesses social inequity caused in part by household income inequality, cognizant of householder preferences. Previous research investigated the issue of an aging, shrinking population in Japan and social inequity outcomes without stakeholder weightings, in order to develop a visualization metric. Building on this research, and in order to focus on societal fairness, the research question to be addressed the evaluation of social inequity overtime through the estimation of future household environmental footprints including factor importance weighting derived through stakeholder engagement.

The proposed IOSEF methodology utilizes multiple data types including, socio-economic statistics and input-output life cycle inventory (IO-LCI) data, and, stakeholder preferences, extracted from a large-scale national survey. The first part of the methodology includes an estimation of household consumption footprints from 1990 to 2005 based on data in the Japanese Input-Output Tables, and, to enable future projections from 2005 to 2040, data from the National Institute of Population and Social Security Research regarding the number and income class of future households is used. The second part consists of stakeholder (households) weighting of critical consumption-based footprints, derived from an evaluation of precedential literature regarding environmental injustices. These six footprints, representing public bads which cause social inequity include greenhouse gases (GHG), energy, water resources, waste, particulate matter (PM2.5), and rare metal (neodymium) usage risk. Stakeholder weightings are drawn from a large-scale national survey conducted in 2018 (Chapman and Shigetomi, 2018b).

Finally, an assessment of social inequity is undertaken to quantitatively define both the overall level of inequity resulting from household consumption, as well as the origin of the consumption burden in terms of income level.

The findings of this research suggest that from 1995 onwards, consumption burden will most heavily impact upon households with incomes below the national average. This phenomenon is due to two factors, firstly, through an aging society which increases the number of households in the low-income brackets, and, secondly, due to the consumption patterns of higher income households. In terms of overall social inequity, the peak is experienced in the year 2010, after which social inequity decreases. This trend is interesting because it is different from the majority of footprints, which peak around 2020 and we assume that this is due to the demographic shift which increases the number of lower income households. When contrasting business as usual and weighted scenarios post 2020, we find that social inequity is decreased further suggesting that people's preferences, and therefore their likely future behavior will have a positive effect on both the environment and social equity outcomes.

Macroeconomic impact of the energy technologies changes in Russia: input-output approach

Topic: Modelling energy use and production in interindustry models
Author: Alexander Shirov
Co-Authors: Andrey Kolpakov

Research question
The world energy sector is dynamically transforming under the influence of new technologies in the fields of road transport, electricity generation, energy efficiency, digitalization and automation. The spread of new technologies leads to a change (*changes) in the structure of energy resources and construction materials consumption, trade and anthropogenic emissions. This means a large-scale change in the structure of cost and value added in the economy. With the spread of electric vehicles and renewable energy sources we should estimate CO_2 (carbon) emissions in the most complex way. These technologies are characterized by zero emissions at the stage of use, but significant amount of pollution is concentrated at production and recycling stages. Therefore, it is important to estimate the total life cycle emissions, taking into account inter-industry interactions and the composition of the economic activities included in the technological chains.
This research problem is strongly relevant for Russia, since a significant share of exports and budget revenues are provided by the national energy sector, which is based on fossil fuels. The adaptation to the world energy sector transformation is of high priority for the Russian economy.

Methods used
The calculations are made using the dynamic inter-industry model, which is developed by the Institute of Economic Forecasting of the Russian Academy of Sciences and called RIM. It belongs to Inforum-type Input-Output models and involves an econometric calculation of the final demand and value added elements, as well as particular technological coefficients. In the RIM model, the nomenclature of economic activities includes 44 items. The model includes energy balances, corresponding to the International Energy Agency methodology, and the unit for CO_2 emissions calculating.

Data used
The basis of our approach is input-output tables for Russia for 1980-2015. We use the data of the Russian national accounts system, National inventory report about anthropogenic emissions and WIOD database.

Novelty of the research
The novelty of the research is determined by the development of a dynamic inter-industry model for the Russian economy, as well as the modeling of a number of technological coefficients. Such problem statement is implemented in the Russian economy for the first time.

A hidden environmental burden: including capital in the material footprint of final consumption

Topic: IO modeling: Consumption-based accounting
Author: Carl-Johan H. SÖDERSTEN
Co-Authors: Richard WOOD, Thomas O. WIEDMANN

The global use of materials has been expanding rapidly in the last century. As the manufacturing of goods becomes more globalised, international trade volumes keep rising and the supply chains of products become increasingly complex, making global flows of materials more difficult to follow. Environmentally extended multi-regional input-output analysis (EE MRIO) can be used to trace these material flows and to calculate consumption-based (CB) indicators of material use, which assign resource use to final consumers rather than producers. CB indicators, such as the material footprint, have been used to analyse whether countries have succeeded in decoupling resource use from economic growth. These indicators, however, are not well suited to calculate the resources embodied in the goods for final consumption, since they do not include the materials embodied in the capital goods. As roughly 50% of metals and 60% of non-metallic minerals are destined for capital formation, the material footprint of consumption as it is currently calculated greatly underestimates the materials used to produce final consumer products. In this paper, we introduce a new indicator of material use, which includes all the materials used along the supply chain, including those embedded in capital goods. Using the EXIOBASE3 EE MRIO database, we apply this indicator to calculate new material footprints that enable to assess whether an actual decoupling of material use from economic growth can be achieved, looking both at specific types of raw materials as well as aggregated measures of material use.

Applying input-output analysis for assessing socioeconomic effects of different technological configurations of straw recovery for electricity production

Topic: Thematic IO analysis: Social and Socio-Economic Analysis
Author: Alexandre Monteiro Souza
Co-Authors: Marcos D.B. Watanabe, Terezinha de Fátima Cardoso, Tassia Lopes Junqueira, Marcelo Pereira da Cunha, Antonio Bonomi

Sugarcane straw recovery has a great potential to be used as a source to generate bioelectricity to supply energy demand in Brazil. SUCRE (Sugarcane Renewable Electricity project) aims at supporting the production of electricity with low emission of greenhouse gases (GHG), through the use of available straw, due to green sugarcane harvesting. Besides the economic and environmental impacts associated with straw recovery and using systems, the social assessment is very important to achieve more sustainable energy production systems. This paper makes use of a simulation framework (the Virtual Sugarcane Biorefinery) to assess how straw recovery technologies aiming at producing electricity affects social aspects such as job creation, occupational accidents, wages, workers' mean schooling and the participation of the woman in the workforce considering the entire supply chain. The social assessment is based on the Social Life Cycle Assessment (SLCA) methodology and comprises the simulation of agricultural and industrial scenarios followed by the application of an Input-Output Analysis (IOA), in order to estimate the mentioned social effects related to the sectors involved in the supply chain. IOA is performed using the Brazilian input-output matrix at national level and data (regarding social effects) from Brazilian official databases. Moreover, sensitivity analysis of important simulation parameters such as recovery system (bales and integral), transportation distances, fraction of

recovered straw, electricity production yield (kWh/ton of sugarcane), among others will be performed to evaluate their potential impacts on the social sustainability. This study is important because of the lack of data concerning social effects associated with electricity production from biomass in Brazil. Moreover, it is a new example of the application of IOA in the SLCA for the quantification of social and socioeconomic effects.

Modelling Inter-Regional Trade Flows: A new method based on Generalized Radiation Model and Multi-Regional GRAS Technique

Topic: IO Data: Development of input-output data and their analysis
Author: James Squibb

IMPLAN has used the gravity model to estimate inter-regional trade flows among different regions in the U.S. Even though the gravity model has been considered the best option to model human commuting patterns, it requires data to estimate parameters. For many international regions, there are no data available to estimate any parameters; therefore, we explored a parameter-free method to model the inter-regional trade flows. This new methodology applied the generalized radiation model and the multiregional generalized RAS (MRGRAS) techniques, which could estimate inter-regional trade flows consistent with a system of regional and national supply and use tables.

This paper describes in detail the method applied in the regionalization process, which includes two steps. The first step is to calculate initial estimates of inter-regional trade flows by applying the generalized radiation model proposed by Masucci et al. (2013). The second step is to balance inter-regional trade flows by applying the MRGRAS technique proposed by Temursho et al. (2018). Trade flows are estimated by distributing the trade over the regions, given the amount produced and consumed in each region. We use supply and use tables and national accounts data from Eurostat, combined with trade estimates from WIOD and European Commission Joint Research Centre's experimental Figaro dataset.

The radiation model was first proposed by Simini et al. in 2012. It became prevalent on the grounds of its simple form and parameter-free property. In 2013, Masucci et al. introduced a generalized radiation model, which overcame some limits of the original model while maintaining its nature of universality. The radiation model was introduced to track human movements in mobility systems. In our project, we apply the model to track goods and services movements, which are the commodity trade flows among regions.

The MRGRAS technique is an extension of the GRAS method. Besides the substitution effects and fabrication effects in the original GRAS technique, this extension added a third dimension of "technology effects", which indicates the general rise or fall in importance of product i for sector j. In our project, instead of adding the "technology effects", we add "regional effects" as the third dimension, which captures trade flows between regions, and also control the aggregated trade flows to the total regional supply and use. In effect, we adjust regional trade estimated at NUTS3 level to national trade controls.

Using Dynamic General Equilibrium Models to Quantify the Macroeconomic Impact of Protectionist Trade Policies

Topic: Modelling the effects of Brexit I
Author: Joseph Bowlin Steinberg

The spectre of protectionism looms large over the world economy, raising an urgent need for macroeconomists and trade economists to provide accurate quantitative answers about the impact of potential protectionist actions. Input-output data has been used extensively to study the long-run effects of increases in trade costs, but few researchers have used this data to analyze important questions about the dynamic effects such as:
- How costly is the process of adjustment that follows an increase in trade costs?
- What is the impact of increased trade costs on trade imbalances?
- Is uncertainty about trade policy costly?

In this paper, I develop a dynamic general equilibrium model with a rich multi-sector, input-output production structure and use it to analyze the short- and long-run consequences of two high-profile forms of protectionism: Brexit and NAFTA termination. My quantitative approach is to calibrate the model's parameters so that its steady state replicates input-output data from the World Input Output Database (WIOD), and then use global methods to solve for the transition equilibrium that follows unexpected changes in trade policy.

In my application to Brexit, I demonstrate how the model and its solution method can be extended to include heterogeneous firms that pay sunk exporting costs as in Das et al. (2007) and to incorporate uncertainty about the form that Brexit will take. I find that the total consumption-equivalent welfare costs of soft and hard Brexit are 0.4 and 1.2 percent, respectively, but less than a quarter of a percent of these costs are due to uncertainty.

In my application to NAFTA, I demonstrate how the model can be extended to include trade adjustment costs that can be calibrated so that the model delivers endogenous trade elasticities that are low in the short run and high in the long run. I find that NAFTA termination would cause regional trade flows to fall dramatically in the long run, particularly in
sectors like agriculture, where tariffs and trade elasticities are high, but the transition to the new post-NAFTA equilibrium entails a lengthy adjustment process. Moreover, contrary to U.S. President Trump's claims, NAFTA termination would have little impact on regional trade imbalances.

Drivers of Deindustrialisation in Internationally Fragmented Production Structures

Topic: DP5 Discussants: Satoshi Inomata, Fernando Perobelli
Author: Erika Stracová
Co-Authors: Martin Lábaj

We study the drivers of deindustrialisation in major developed countries over the last two decades. In contrast to some recent studies, we show that the importance of manufacturing for the world economy has not declined during this period. We argue that the observed deindustrialisation measured by direct employment and value-added shares of manufacturing underestimates the importance of manufacturing. Many in-house activities of manufacturing are nowadays outsourced to other industries and are not accounted for in the direct statistics. We

show that at least in major developed countries the level of outsourcing reached its limits at the beginning of the new millennia. At the same time, the offshoring of activities interlinked with manufacturing became a dominant driver of deindustrialisation in these countries. We are the first to study the importance of manufacturing in a truly global perspective and final consumption expenditures approach that allows us to consistently analyse the role of i) outsourcing ii) offshoring and iii) changes in final demand, in its development.

Rebound effects in the bio-based Economy

Topic: Thematic IO analysis: Sustainable Production, Consumption, Technology and Innovation
Author: Gerhard STREICHER
Co-Authors: Mathias Kirchner

Rebound effects in the bio-based Economy
Gerhard Streicher, Mathias Kirchner

Current research in the fields of chemistry and microbiology will likely lead to major shifts in the kind of physical resources used in industry. In this article we explore the possibility of replacing fossil feedstock (provided by the petrochemical industry) with feedstock derived from bio-based materials (biomass produced in agriculture and forestry) in the production of polymers and plastics. The immediate impact will be to shift demand for resources away from oil producers to suppliers of biomass. Not least, this offers the potential for much more "local" sourcing of inputs used in the polymer industries.
However, insofar as these bio-based inputs have to be produced themselves, this will lead to higher output in the agricultural and forestry sectors. This can be met by either increasing the area under development or increasing the intensity of cultivation; either way, at least part of the reduction in demand for fossil fuel in the plastic industry will be offset by higher demand for energy inputs to satisfy the higher demand for biomass ("technological rebound"). Also, trade linkages are likely to adapt to these new demand aspects. Using a combination of three models, a global agricultural model (GLOBIOM, provided by the International Institute for Applied Systems Analysis IIASA), a regionally highly disaggregated agricultural model for Austria (PASMA[grid], developed by the Institute for Sustainable Economic Development at the University of Resource Sciences in Vienna) and WIFO's own multiregional econometric IO model (FIDELIO resp. ADAGIO), we attempt to identify these regional and "productional" shifts in the agricultural and forestry sectors. A key issue will be the estimation of the "technological rebound effect".

The Estimation of Import Consumption Dynamics in Input-Output Models

Topic: Methodological aspects of input-output analysis
Author: Liubov Strizhkova
Co-Authors: Maria Selivanova, Liudmila Tishina

The article is devoted to the issues of Input-Output modelling in two inter-related dimensions connected with estimation of import matrix. The first dimension aims to development of the approaches to estimation of import consumption in sectors of national economy. The second dimension focuses on estimation of volumes of transferred value of intermediate imports to value

of national output for internal final consumption and exports.

Objective limitations in national statistics determine the complexity of research in the concerned dimensions. So the requirement in solving these problems is very applicable. It is important for estimation of national economic development prospects, for effective foreign trade policy-making. This appears to be the reason of actuality of the article, which takes under consideration the mentioned aspects.

In the first part of article the task of import real demand of main types of intermediate products forecasting was formulated as a problem and solved. Also the way to include these forecasts in Input-Output model, when we estimate shifts in the structure of direct costs matrix, was introduced. In the second part of article the problem of decomposing the value of final national output on national and foreign GVA and net taxes on products was solved. While working at this problem the classical IO model has undergone transformation.

The article contains a description of possible ways to overcome informational limitations, including the solutions found in the field of model constructions for research purposes. Also the quantitative estimates of the results of this method application for Russian economy are given. They include the description of the specification of real import demand functions for the most important types of intermediate products; the estimates of the economy response to shifts in intermediate imports demand, taking into account intersectoral relations and changes in the share of intermediate imports in total value of national output for final consumption, gross capital formation and exports over the last years.

Engineering-level input-output modeling for low-carbon infrastructure planning

Topic: Using IO to Advance Investments in Efficiency, Resilience, and Sustainability
Author: Sangwon SUH

Avoiding the most dangerous consequences of climate change requires balancing anthropogenic greenhouse (GHG) emissions with natural sinks by the second half of this century. To do so, the global economy is expected to need 50-100 trillion USD infrastructure investments for low-carbon transition over the next a few decades. The types of infrastructure need to be addressed include energy (generation, transmission, and storage infrastructure), transportation (public transportation, road, and charging infrastructure), built environment (commercial and residential building infrastructure), and industrial production (manufacturing infrastructure). In this presentation, I will discuss a number of recent examples where engineering-level input-output data are used in an input-output framework to quantify carbon mitigation potential. First, the Green Technology Choice project by the international resource panel (IRP) examines over 60 low-carbon technologies in terms of their life-cycle GHG mitigation potential by integrating engineering- and sector-level input-output data with environmental extensions. The results show that both low-carbon energy supply and energy demand management technologies are needed for substantial GHG reductions. Second, The Weight of Cities project by IRP analyzes the impacts of deploying low-carbon infrastructure for bus rapid transit, district heating, green commercial building, and strategic densification of urban systems applied to over 84 global cities. The results show that GHG footprint of these cities would increase by 58%–116% by 2050. Low-carbon infrastructure and strategic densification, however, have the potential to curve down GHG emissions to 17% below the 2010 level in 2050. Finally, a series of articles by Kätelhön and colleagues examine chemical production processes and their GHG mitigation potentials using technology choice model, which is an engineering-level rectangular input-output model. These papers show that engineering data can be integrated into rectangular input-output structures for technology-choice questions. Toward the end of the presentation, I will discuss the benefits as

well as the challenges in using engineering level data, and the synergies between the input-output and engineering communities working in the field of low-carbon transition.

The Effects of Automation on Reshoring Activities

Topic: Classical IO applications: Trade and GVCs
Author: Viktória Švardová
Co-Authors: Martin Lábaj

In this paper we identify the industries where the higher usage of industrial robots in the production process may trigger reshoring activities. Backer et al. (2018) stated that there is a tendency that the pace of the growth rate of global value chains is slowing down in the last few years. This is caused by reshoring activities which are triggered by the increased automation. Krenz-Prettner-Strulik (2018) found a relationship between reshoring and automation. Based on their estimates, an increase by one robot per 1000 workers is associated with a 3.5 % increase in reshoring activities within the manufacturing industry. The main aim of the paper is to identify the effect of automation on reshoring activities in manufacturing industries controlling for other potential sources of reshoring. The analysis is based on World Input-Output Database, KLEMS 2017 Database, and data on the operational stock of industrial robots from International Federation of Robotics (IFR). IFR database contains data provided by nearly all industrial suppliers worldwide that cover production, import, export and domestic installations or shipments of industrial robots by industries. WIOD covers 43 countries and 56 sectors for the years from 2000 until 2014. The newest data were released in 2016. Socio-economic accounts complementing these data were released in 2018. These data provide appropriate information about the compensation of employees, number of employees, labor and capital compensation and other indicators that will be used as covariates in regression analysis. KLEMS database contains more detailed data about socio-economic accounts for European countries. It involves data about output, capital files that are broken down into values, volumes and it also covers data about growth rate of value added and labor productivity (value-added per hour worked and per person employed).

The Inter-Regional Impact of a Balanced Budget Regional Fiscal Expansion: No Detriment, No Danger

Topic: New techniques, constructions and applications of Social Accounting Matrices
Author: Kim Swales

In the UK Independence Referendum, the Scottish electorate voted to remain within the UK. However, this did not mean that the institutional arrangements in Scotland would remain unchanged. Legislation already enacted under the 2012 Scotland Act plus that subsequently implemented from the Smith Report have given Scotland extensive fiscal powers. However, although there is a highly devolved structure for taxation and public expenditure, the Scottish economy is closely integrated with the rest of the UK and issues of policy co-ordination and misaligned incentives are almost inevitable.

The paper develops an extremely simple two-region demand-driven analytical model, which is used to illustrate the nature of inter-regional interaction that would occur as a result of devolved policy initiatives. We construct a set of two-region (Scotland/RUK) Social Accounting Matrix accounts. These are used to construct models to calculate the impact of decentralised and

devolved policies. Whilst the specific case of Scotland is the focus here, the issues raised are of importance in general for spatially rebalancing the UK economy. The simulation results highlight the potential significance of inter-regional effects and the requirement for accuracy in size of inter-regional trade flows.

Supply Chain Performance Measurement based on the MRIO Framework: A Case Study of the Two-stage Network in the Steel Industry

Topic: Thematic IO analysis: Energy and Environment
Author: Hirotaka TAKAYABU
Co-Authors: Shigemi KAGAWA

Performance measurement of supply chain management (SCM) is crucial for mitigating greenhouse gas emissions such as CO2 emissions through improving inefficient supply-chains of a specific decision making unit (DMU). The data envelopment analysis (DEA) is widely used for not only identifying technically-inefficient DMUs by evaluating efficiency scores but making an efficiency improvement strategy of the DMU. The novelty of this study is to extend the conventional DEA framework for the supply chain performance measurement based on the multi-regional input-output (MRIO) framework. In this study, we focused on CO2 intensive global supply chain networks between steel manufacturing industry (MANUFACTURE) and energy supplier for the steel manufacturing industry (SUPPLIER). In doing it, we used the EXIOBASE 3 and made an inventory database for energy consumption, labor force, intermediate input, and gross industrial output of MANUFACTURE and SUPPLIER in 47 countries during the study period between 1995 and 2010. A combined efficiency score calculated from efficiency scores of the MANUFACTURE and SUPPLIER of a specific country (i.e., performance of the steel supply-chain of a specific country) was estimated by the proposed DEA framework. The combined efficiency score ranges from zero to one and a higher efficiency score indicates a more efficient supply-chain. The results show that there were 7 efficient SUPPLIERs and 15 efficient MANUFACTUREs among 47 countries in 2010. Average efficiency score of the MANUFACTURE of countries has increased from 0.853 in 1995 to 0.879 in 2010, while average efficiency score of the SUPPLIER of countries has increased from 0.690 in 1995 to 0.704 in 2010. We found that the efficiency gap between SUPPLIERs was larger than that between MANUFACTUREs. We finally provide an effective policy toward the green SCM with a focus of energy and country substitutions in the inefficient steel supply-chains identified in this study.

Revisiting Factor proportions in the Indian Economy – A Semi-Input-Output Approach with focus on tradable sectors

Topic: Classical IO applications: Industrial economics, Productivity and Efficiency
Author: Anjali Tandon

Literature on factor productivity is essentially based on measurement of factor intensity for sectors of the economy. However, the measurement of factor intensities is restricted to their direct use within the sector ignoring the crucial fact that factors are also embedded in upstream sectors. Therefore, an underestimation of the factor intensities across sectors of the economy cannot be ruled out if evaluated using direct factor contents only. An a priori external influence on demand (through exports) and investment (through FDI), is expected to shape the allocation of production. It will be insightful to see structural coherence of factor endowments with output,

exports and FDI, separately for each tradable sector of the economy. Likewise for factor intensities, tradable are also studied in isolation for their interaction with the non-tradables. The use of Semi Input-Output (SIO) modelling, however, permits to account for their interaction.

This paper has two objectives for studying the tradables using an SIO approach and the KLEMS data from the RBI. First, to assess the extent of underestimation of the factor intensities upon the additional accounting for indirect factor intensities. Second, to study the structural coherence of factor intensities with output, exports and FDI.

The factor proportions (K-to-L) show a significant underestimation of the factor intensity for the economy in comparison to when accessed with direct proportions only. Taking into account of the complementarities generated by the tradable sectors on the non-tradable sectors, the average K-to-L ratio for the tradable sector appreciates notably from 2.7 to 3.9 upon accounting of the linkage effects. Although the output and export distributions are largely aligned with factor endowments; the distribution of FDI is skewed towards sectors with high capital proportions. From a policy perspective, FDI is unlikely to be solution to the employment generation problem without re-orienting and enhancing the existing skills.

Keywords
factor proportions; tradables; capital-to-labour ratio; semi-input-output; linkages; india

The Mexican single country E-SUT 2013, Methodology and results

Topic: IO Data: Development of input-output data and their analysis
Author: Jose Teran-Vargas
Co-Authors: Rodolfo Augusto Ostolaza-Berman

This papers presents the methodology and results for the compilation of a Mexican single country Extended Supply and Use table (E-SUT), it shows the NSO efforts implementing the OECD terms of reference on the subject. The E-SUT disaggregation considered the orientation by activity for 20 sectors: a) Exporters; b) Ownership (domestic and foreign); c) Size of the Economic Unit, and d) foreign and domestic integration on inputs.

The purpose on this paper is just to show the methodology and main problems to the national accounts expert community.

Given the fact of the characteristics of an informal small business economy combined with large enterprises this E-SUT was only possible for a single year and through the exhaustive use of the Economic Census. The economic unit of study is the "establishment" instead of firms.

The E-SUT keep the same structure and GDP of the national SUT, accomplishing the first definition of a satellite account through the activities splitting.

The results of both supply and intermediate demand are presented, the novelty is the deep insight into activities by sector with characteristics above mentioned, even though the limitations to disaggregate by row.

A New Global CGE Database

Topic: IO modeling: Computable General Equilibrium Modeling and Social Accounting Matrices
Author: Karen Thierfelder
Co-Authors: Scott McDonald

This paper provides details about a new global database designed primarily for use by Computable General Equilibrium (CGE) modelers. While there are other global databases for CGE analysis and analysis using fixed price models, it is argued that these databases lack important features that are desirable in CGE models, e.g., current account transactions other than trade balances. The distinctive features this database are: its construction in accordance with the principles of the SNA; it presentation in the form of a Social Accounting Matrix (SAM); the domestic transactions data are presented as Supply and Use Tables (SUT); transactions between domestic and international institutions are explicitly identified; and the database is designed to make the process of extending transactions data and augmenting the database with satellite accounts straightforward. The database relies on the work of others, principally WIOD, and builds on research that extends and augments the GTAP database to include current account transactions. The primary purpose of the database is to demonstrate a "better mousetrap" in the hope that it will encourage the international input-output (IO) and CGE communities to develop 'complete and consistent' databases that are robust.

Reliability of using Periodic IO Data to Identify High Return Investments in Efficiency and Environmental Sustainability: An Examination of US Manufactured Tech Products

Topic: Using IO to Advance Investments in Efficiency, Resilience, and Sustainability
Author: Douglas S Thomas

This paper identifies industries within the supply chain for 50 high-tech assembly-centric commodities that have pervasive costs and environmental impacts. Previous examinations have shown that expenditures for research and development in high economic cost areas (e.g., the cost of metal for producing a vehicle) tend to have a higher return on investment than expenditures on low cost areas. Public entities and trade associations could achieve a high return on investment by targeting research and development expenditures in such areas. The results of this analysis show that a minimum of 90.1 % of industries in the supply chain, above the 80th percentile for environmental impact, appear in 2007 and 2012 for each of the 50 commodities. For value added it is 86.4 %. Moreover, high-impact high-cost items are pervasive over time. Eleven industries in the supply chain are above the 80th percentile in both value added and environmental impact for all 50 commodities. These items affect numerous industries and people. Four industries in the supply chain are pervasive over time and across commodities: "Electric power generation...," "Oil and gas extraction," "truck transportation," and "Iron and steel mills..." These 4 represent industries in the supply chain that are high environmental impact (above the 95th percentile), high cost (above the 95th percentile in value added), and span across numerous commodities while stretching over at least a 5-year period. Research that reduces the consumption of these items or improves the efficiency of producing them will, likely, result in a high return on investment.

Trace important coefficients for China's upgrading in global value chains

Topic: Classical IO applications: Trade and GVCs
Author: Kailan TIAN
Co-Authors: Erik DIETZENBACHER, Bingqian YAN

International fragmentation of production has become pronounced, with firms at specific countries carrying out specialized activities in global value chains (GVCs). China has successfully involved in GVCs and become one of the most important engines for the recent trade boom by starting from the assembly part of GVCs. However, the value-added content of such assembly activities is much lower than that of other activities. As the growth rate of Chinese economy slid down to a medium level under the so-called "New Normal" state, it has become an urgent request for China to move up the GVCs and increase its value-added share in the global production networks. In response, the main aim of this paper is to identify those important elements (coefficients) in world direct-requirements matrix for which a small change in their levels maximizes China's value-added share in GVCs. That is, to trace important coefficients for China's upgrading in GVCs. To implement this study we employ the nonlinear optimization method. The goal of this optimization is to maximize the value-added share of China in the framework of a global IO model assuming some constraints hold true (or reasonable). If there is a global solution for the optimization problem, we can identify the important coefficients according to their importance. By employing the multinational IO tables from World Input-Output Database (WIOD), we can capture not only domestic important coefficients, but also international ones. The former allows one to understand in which (important) sectors of China should competitiveness be improved in order to enhance China's upgrading, and the latter provides information about which sectors in which (other) economies most affect China's upgrading in GVCs. We conduct this study to provide answers for questions regarding what the main directions of the future macroeconomic policy of China could be in order to increase its share in global value-added.

Environmental and economic impacts of Brexit in the consumption of vegetables and fruits in RU

Topic: Thematic IO analysis: Sustainable Production, Consumption, Technology and Innovation
Author: Maria A. Tobarra-Gomez
Co-Authors: Luis A. LOPEZ, Andre Carrascal Incera, Raquel ORTEGA ARGILES

Brexit, particularly depending on its final version, is bound to have important effects on trade as well as on other socio-economic and environmental issues. Trying to give an assessment on these questions, we apply a multi-regional input-output model, extended with international trade data, to evaluate the economic and environmental impacts from Brexit in terms of consumption of fruits and vegetables in the UK. To this aim, we followed the methodology already applied to Spanish fresh produce consumption developed in Tobarra et al. (2018). Detailed trade data from customs (HM Revenue & Customs database) allow us to include an accurate demand vector for the current situation and future potential scenarios.
Certainly, a no-deal Brexit will reduce the availability of fruits and vegetables imported into the UK from EU countries. Therefore, this reduction will generate a substitution effect, being these goods potentially replaced either by domestic production or by imports from other regions. Among other effects, this change in trade patterns, would affect where the production is located, and consequently where the jobs are created and how much resources are needed in the process. Additionally, as a by-product, this would imply also a change in the levels of CO_2. In this

paper, we calculate the footprint balance linked to these import changes as the difference between the footprint from imported fruits and vegetables from the EU and the footprint using a substitute origin (UK or third countries/regions). A positive sign in that avoided footprint balance would indicate a positive result, since the trade substitution outcome is linked with a lower footprint. On the contrary, a negative sign would be linked to a negative impact (increasing the footprint) caused by the trade diversion.

A second objective in our paper is to analyse economic vs. environmental impacts from the potential Brexit trade substitution effect. In other words, we aim to identify the potential synergies or trade-offs between the economic and environmental results. These include carbon and water footprints for assessing environmental impacts and employment footprint for economic effects.

Keywords: Environmental footprints, Brexit, trade patterns

Tobarra, M.A., López, L.A., Cadarso, M.A., Gómez, N., Cazcarro, I. (2018) Is Seasonal Households' Consumption Good for the Nexus Carbon/Water Footprint? The Spanish Fruits and Vegetables Case. Environmental Science & Technology 52, 12066-12077.

Boosting Economic Competitiveness: The Industrial Clusters in Input-Output Networks

Topic: Methodological aspects of input-output analysis
Author: Shohei TOKITO
Co-Authors: Fumiya NAGASHIMA, Tesshu Hanaka

Porter (1998) suggested an importance of forming regional industrial 'clusters' and pointed out that it is an indispensable source to promote regional competitiveness, innovation, and growth. Countries facing the deindustrialization and the decline of local industries aim to enhance the national competitiveness by improving business environment through forming the industrial clusters. The countries have to identify economically-important industries to promote the territorial and extensive industrial clusters. The inter-industrial relationship consists of huge and complicated network and it makes difficult to analyze a comprehensive structure for the formation of clusters. Many previous studies analyzed an actual network structure (e.g., communication network, traffic network, etc.) by using the graph theory. In the input-output analysis, Liang et al. (2016) applied the concept of betweenness centrality to the IO-based supply-chain network and developed a structural path betweenness with a focus of multi-production layers. As in the spirit of Liang et al. (2016), this study defined a new concept of 'clusterness' and developed a novel method to identify economically-critical industries in terms of clusterness considering the multi-layer graphs originated from the nature of inter-industrial network. We used the EXIOBASE and calculated the clusterness scores with a focus of the Japanese industries. The result shows that industries related to steel production had the higher clusterness scores, and it indicates the Japanese steel industries played a central role in forming larger clusters in the global supply-chains. Relevant economic policies for enhancing domestic industrial clusters associated with Japanese steel industry and incorporating this high-clusterness industry into global supply chain boost domestic economy through the linkage in industrial clusters.

Assessing the impact of large-scale community investments in Developing Countries: application of a Multi-regional Input-Output model to a case study in Congo

Topic: DP3 Discussants: Rossella Bardazzi, Doug Meade
Author: Francesco - Tonini
Co-Authors: Matteo Vincenzo Rocco

The interest of the international community for sustainable development and the multiple interconnections among energy, environment and society has widely increased. As highlighted by interlinkagies of the 17 SDG's of the 2030 Agenda, energy has started to be considered as a key means for assuring sustainable and equitable access to basic needs and for supporting local enterprises and creating new jobs opportunities. Within this framework, the private sector may initiate effective actions of technological cooperation with an impact on the different dimensions of development: environmental, social and economic. This calls for a proper evaluation approach able to capture the complexity of current challenges.

In this paper, the application of a Multi-Regional Input-Output (MRIO) model coupled with an econometric production function is proposed to assess the prospected economic and environmental impact caused by community investments in the energy field. This approach provides a multi-dimensional complexity of results: economic and environmental impact can be distinguished by country, sector and type. More specifically, Open and Closed Multi-Regional Input-Output models have been jointly adopted to distinguish between direct, indirect and induced impact.

The model is applied to a case study in Congo, consisting in the deployment and operation of a large-scale power plant, which contributes to the generation of about 70% of the electricity production in the country. Macroeconomic and environmental data are retrieved from the EORA Multi Regional Input-Output database, while data required to calibrate the econometric production function are retrieved from World Bank database. Results shows that almost 50% of the economic impact is generated in Congo of which 28% is directly and 72% is indirectly caused by the energy project. The induced impact in Congo is negligible while counts for the 85% of the impact generated abroad. Same kind of results but different in magnitude are obtained for environmental indicators.

Input-Output Linkages and Productivity Propagation

Topic: Classical IO applications: Economic Structural Change and Dynamics
Author: Luis Daniel TORRES
Co-Authors: Advait Rajagopal, Jangho Yang

In this paper we investigate how Input-Output linkages are structured, how these indicators of industry interdependencies interact with productivity shocks, and how they are related with country's economic growth performance.

We make use of the World Input-Output Database (WIOD) to construct different variables for 43 countries and more than 50 industries for the period of 2000-2014. Using the World Input-Output Tables (WIOT) we construct 8 different indicators of total forward and backward linkages using the Leontief and Gosh inverse. In addition, the WIOT database is used to construct country level GDP measures in current values which are then deflated using GDP deflators from the Penn World Tables v 9.0. Finally, the Socio-Economic Accounts from the WIOD are taken to construct the rate of cost reduction (RCR) at an industry level. The RCR is relevant variable within the theory of

induced technical change and corresponds to the negative of the total factor productivity growth.

We conduct a series of statistical exercises to the database. First, we study the empirical distributions of the different linkages indicators and the RCR. The same exercise is conducted to the linkages indicators weighted by industry level RCR. Second, we use Bayesian estimation techniques to fit probabilistic models to these weighted and unweighted linkages measures. Lastly, we do regression analysis to study the relationship between country GDP growth and country-wide measures of the different input-output linkages indicators.

We find that the cross-sectional empirical distributions of many linkage indices have a persistent heavy-tailed pattern, indicating that a small number of industries play an important role in the supply-chain network. By combining the information from the structure of production and technical change, we find that the I-O network is wired in a different manner in each country such that some countries have higher linkages for higher productivity sectors while other countries have a lower linkage for higher productivity sectors. We propose a measure of "efficiency" of a network by taking the difference between the network weighted RCR and non-weighted RCR. The empirical evidence shows that this network efficiency is highly correlated with country' GDP growth.

Thirlwall's Law and uneven development under Global Value Chains: a multi-country input-output approach

Topic: Mathematical Analysis and Thematical Applications
Author: Andrew Brian Trigg

A notable macroeconomic explanation of uneven development, with particular relevance to developing countries, has been the problem of balance of payments constraints, as captured by Thirlwall's Law: where relative growth rates are explained by differences between income elasticities for exports and imports. Araujo and Lima have developed a one-country multisectoral disaggregation of this hypothesis using a vertically integrated input-output framework, which is extended here in two main ways. First, international trade in intermediate inputs – the basis for Global Value Chains – is introduced; second, the model is extended to multiple countries. The main outcome of the paper is the development of a new multisectoral method for modelling balance of payments constraints: a Multi Country Sectoral Thirlwall Law (MCSTL) under which key sector relationships are nested in intercountry trading relationships that encompass both intermediate and final goods. The identification of this input-output structure is developed in analytical stages, moving from a one-country vertically integrated system, to two, three and finally multi-country systems. In addition to its theoretical contribution to understanding the industrial structure of trade, an implication of this multi-country/multi-sector approach is that it can also be tested in future empirical work using the recently available World Input-Output Database of national tables.

Beyond Carbon Leakage: Off-Shoring of Employment and GDP in Decarbonizing International Supply Chains

Topic: Thematic IO analysis: Energy and Environment
Author: Karen Turner
Co-Authors: Frans P de Vries, Antonios Katris

Introduction
Industrial decarbonisation is a major challenge in terms of both emissions reduction and the 'just transition' element of the 2015 Paris Agreement. It raises issues of potential carbon leakage and associated off-shoring of jobs and economic value if carbon reduction policies impact the location decisions of industry. We use IO multipliers to help quantify the extent of these potential displacement effects. Focussing on cement production as a particular decarbonisation challenge, we consider the following research question: how might displacement of currently EU-based production activity impact jobs, GDP and CO2 emissions at national and global levels?
We propose that economic multiplier metrics can help quantify the extent of these potential displacement effects. Using interregional input out methods, applied using the World Input-Output Database, we focus on cement production as a particular decarbonisation challenge, to consider the potential impacts of displacing currently EU-based production activity to other countries.

Key results
We use 'economic multipliers' to consider the extent to which emissions, jobs and value-added currently generated both within existing national EU-based industry and upstream supply chains may be displaced across borders and potentially increase if production were to relocate. We use German cement production as a case study.

We reviewed the direct and supply chain emissions of cement industries in a range of countries, including one other large cement-producing EU nation, Italy.
We found that Germany and Italy have very similar emissions 'footprints' per $1m of final demand (respectively 0.91 and 0.94 kilotonnes of CO2 produced throughout the global economy per $1m of final demand served by the national industry). We also considered three examples of non-EU cement producing nations: Turkey, USA and China. For these countries, emissions per $1m of final demand tend to be higher. The multiplier value is 1.33 kilotonnes (kt) for the US, 1.79kt for China, although with Turkey more in line with Germany and Italy at 1.0kt (and lower than other EU nations such as Spain and Poland).
The first key insight that can be drawn is that elocating cement production outside of the EU is likely to generate a spatial displacement of CO2 emissions and an overall increase in global CO2 emissions.

A second key result can be drawn from considering comparable multiplier results for GDP and jobs. Here we find that off-shoring of emissions is likely to be accompanied by displacement of GDP generation overseas. This may be associated with a net increase in global employment. Turkey and China have significantly higher numbers of direct and supply chain jobs associated with each $1m of final demand than do Germany, Italy and the USA. On the other hand, the wider GDP value of each job is lower. If we are interested not only in the level but also the quality of employment, we might be concerned at this potential consequence of off-shoring cement production.

A third key result is the importance of domestic supply chain employment associated with cement production. In particular, we analysed the breakdown of supply chain jobs located within

Germany itself for German cement production and found that 38% of these are in the services sectors.

Finally, we analysed cross-border linkages between German cement production and supply chains in other EU states. We found that, because of the interconnectedness of EU members' economies, the wider EU supply chain GDP associated with German cement production is substantial, in particular for the Netherlands.

Conclusions

Our paper presents an example of the type of broader economy analysis that is essential to inform policy consideration of the full range of impacts of potential decarbonisation solutions in terms of actions that may induce retention or relocation of industry activity.

More generally, our analysis highlights the importance of considering how shifting locations for manufacturing processes (such as cement production) from their current locations to ones with less strict environmental regulations may lead not only to an increase in global CO2 emissions but an off-shoring of jobs and GDP that may violate the 'just transition' imperative of the Paris Agreement. In particular, multiplier analyses permit consideration of how jobs and GDP off-shoring will impact not only in the industry itself or be limited to the original host region through a chain of upstream supply chain impacts.

This focuses attention on the need to decarbonise industrial activities in their current locations, by means that do not negatively impact key performance indicators for both industry and the wider economy, such as competitiveness.

Estimation of Vehicle Lifetime in the Used Car Market

Topic: Thematic IO analysis: Transport & Policy Analysis &
Author: Izumi Uchida
Co-Authors: Yuya NAKAMOTO, Shigemi KAGAWA

IEA (2012) has reported that the number of conventional gasoline vehicles (CGVs) owned in the world will decrease by 2050, whereas the demand for next-generation vehicles such as hybrid vehicles and electric vehicles will significantly increase by 2050. With this background, previous studies (e.g., Kagawa et al., 2008, 2011, 2013; Nakamoto et al., 2018) estimated the effects of vehicle lifetime extensions of countries on a specific country and global CO2 emissions and they found that vehicle lifetime extensions played a crucial role in the climate mitigation. Although the previous studies focused on a vehicle life-cycle from a new purchase to vehicle-scrapping and used the physical vehicle lifetime, they did not consider economic vehicle lifetime with a focus of vehicle replacement cycle. The novelty of this study is that we used the detailed micro data on vehicle replacements provided by the Car User Report 2017 (Proto Corporation, 2017) and estimated the economic vehicle lifetime with a focus of a vehicle life-cycle from a new purchase to a car replacement. In doing it, we focused on three vehicle types of CGV, hybrid vehicle, and electric vehicle and assumed their vehicle lifetimes followed a normal distribution or a Weibull distribution. From the results, we found that when car owners 'newly' purchase a CGV, they will replace it after 6.8 years on average. In addition, when car owners purchase a 'used' CGV, they will replace it after 5.4 years on average, thus the economic lifetime of the used CGVs is 1.4 years shorter than that of new CGVs. We further used the stock-flow model of vehicles based on the estimated vehicle lifetime (e.g., Kagawa et al., 2012) and analyzed how car replacement cycles of the three types affected life-cycle CO2 emissions associated with final demand of vehicles during the study period: 1990 to 2030.

Structural Comparison of Small and Medium Enterprises in Malaysia and Thailand

Topic: Enterprise-related input-output analysis
Author: Chakrin UTIT
Co-Authors: Muhammad Daaniyall Abd Rahman, Umi Zakiah NORAZMAN, M. Yusof SAARI

There is a growing concern globally on the importance of small and medium enterprises (SMEs) on the economic growth in developing countries. Composition of SMEs in developing countries is large, but the contribution to output and value added is found to be relatively lower than large firms. Empirical evidences indicate that weak linkages or low level of interdependencies between SMEs and large firms is crucial in explaining the low performance of SMEs. This paper attempts to compare production structures and the level of interdependencies of small and medium enterprises (SMEs) in Malaysia and Thailand. For both economies, SMEs represent more than 98% of the total number of establishments in 2015 and have emerged as a highly vibrant and dynamic driver for the economic growth. Results from the analysis would be able to determine whether SMEs in both countries having the similar structural problems. If that is the case, then a common international policy towards SMEs may be applied. For empirical analysis, we run two SME-input-output (SME-IO) tables that split sectors into SMEs and non-SMEs in both countries. We have constructed SME-IO for Malaysia and for Thailand, the dataset is developed by the Office of SMEs Promotion of Thailand (OSMEP). Using the databases, a novel empirical application is applied to assess the extent to which the production sectors with different sizes affect the economic growth.

The 3D GRAS balancing method: applications to multiregional input-output frameworks

Topic: IO Data: Annual, Regional, and Multiregional Input-Output Accounts and Intra- and International Trade
Author: Juan Manuel Valderas Jaramillo
Co-Authors: Alexis Bolivar Gonzalez

The GRAS is a bi-proportional adjustment method commonly used among input-output practitioners for matrix balancing. It can deal with positive and negative elements [Günlük-Senesen and Bates (1988), Junius and Oosterhaven (2003)]. The literature describes several refinements, such as improving the target function in order to avoid biases [Lenzen, Wood and Gallego (2007), Huang, Kobayashi and Konji (2008) or Lemelin (2009)], dealing with rows and columns with no positive elements [Temurshoev, Miller and Bouwmeester (2013)] or allowing more flexibility to find a compromise solution between inconsistent constraints [(Lenzen, Gallego and Wood, 2009)].
A huge variety of applications benefits of using the GRAS. However, sometimes rather than simply imposing constraints summing row-wise or column-wise all the elements of a matrix, it is necessary to split the matrix into sub-blocks and to impose also constraints on the totals of the sub-blocks. Constraints on a cell-wise sum of elements located in different sub-blocks of the initial matrix might be also necessary. This is the situation in the balancing of multiregional input-output frameworks, where the structure of data and its relationships hampers the direct application of the bi-proportional GRAS method: for instance, to balance a bilateral trade database of exports and imports trying to match not only the bilateral trade values but also overall trade estimates coming from national accounts, such as the use table of imports by countries.

Our method is a tri-proportional extension of the bi-proportional GRAS method for balancing a cube (tri-dimensional matrix). We show that this method is intimately connected to the problem described above of balancing a bilateral trade matrix; it is suited for solving it and can be applied to many similar situations in this multiregional context.

Reducing discrepancies in the construction of inter-country use tables

Topic: Want to know more about how the EU FIGARO ICIO tables were made?
Author: Juan Manuel Valderas Jaramillo
Co-Authors: José M. RUEDA-CANTUCHE, Nadim AHMAD

In the European Union, once that preliminary inter-country use tables are compiled using the balanced bilateral trade views of goods and services data adjusted by goods sent abroad for processing and merchanting activities, the final stage of the construction of the EU inter-country use table consists in removing the resulting discrepancies between the resulting export totals and those from national accounts or from national supply and use tables. These discrepancies are basically the result of the difference between the estimated trade figures in the preliminary estimated EU inter-country use tables and those export figures reported by national supply and use tables.

Ahmad (2017) suggested that misclassification of products can be one of the reasons originating these discrepancies, proposing a method for reducing row discrepancies by means of a re-classification of product bilateral flows preserving bilateral trade total figures by partner country in a replicable and transparent method. This method is based in the construction of a conversion matrix that reallocates products with surpluses (positive discrepancies) into products with negative discrepancies till one of them (either positive or negative discrepancies) are exhausted and no more reallocations are possible. In this paper, we suggest a different construction of the conversion matrix that avoids the appearance of negative bilateral trade flows when the reallocation process is carried out.

The Ahmad's original approach is implemented before splitting bilateral trade across intermediate and final users. Therefore, just a table with a balanced view of trade by product and trading partner would be required for its implementation. In the FIGARO project, we have extended Ahmad's approach to account for a different distribution by partners and users, such that the allocation process preserves the bilateral trade total figures by partner country and also leaving the totals by users unchanged.

In this paper we describe our new approach from a practical and didactic point of view, emphasizing the solutions given to the problems encountered in the Ahmad (2017) method for the construction of the EU inter-country use tables under the FIGARO Project.

On the Numerical Structure of Local and Nationwide Government Spending Multipliers: What Can We Learn from the Greek Crisis?

Topic: IO modeling: Computable General Equilibrium Modeling and Social Accounting Matrices
Author: Vinicius A. VALE
Co-Authors: Natalia Quiroga Cotarelli, Eduardo Amaral Haddad

We develop a multiregional general equilibrium model for Greece to simulate the short run impacts of temporary deficit-financed rises in government spending. It has been recognized that the fiscal multiplier is a function of structural features of the economy and policy reaction

parameters. Moreover, the debate on the magnitude of the multiplier along the business cycle has also been the subject of disputed debates. On these grounds, we look at the Greek case by calibrating the model using data for distinct states of the Greek economy during the development of the recent crisis. Whether this matters for local and nationwide multipliers depends on qualitative differences of the numerical structures of the model. Our results imply that structural coefficients have a strong effect on government spending impact multipliers. In the case of Greece, lack of information on the changing magnitudes of behavioral parameters over time adds another layer of uncertainty to this debate.

Converting the Belgian 2010 Interregional Supply and Use Table to ESA-2010 rules

Topic: SUT compilation issues relevant for users
Author: Bart M. J. VAN DEN CRUYCE
Co-Authors: Bernhard MICHEL

Paper proposal for the 2019-IO conference. In particular for the organised Eurostat-JRC session on: "supply and use tables compilation issues relevant for users"

Recently, the Belgian Federal Planning Bureau has constructed interregional supply and use tables for 2010. They describe intra and interregional flows between the country's regions Brussels, Flanders and Wallonia. To estimate these flows, we followed a bottom up approach based on VAT data and international trade data at the firm level. The table respects the national SUT for 2010 according to ESA 95 rules (European implementation of SNA93). It has been used by us to calculate regional income and employment multipliers, and by others to estimate the regional carbon footprint for Flanders and the possible impact of Brexit on Belgian regions. It also served as an input for our Belgian macro-econometric regional model.

The aim of the work is to adapt the interregional SUT to ESA2010/ SNA2008 rules and the corresponding new national SUT for 2010. This responds to demands from users for tables compatible with more recent versions of the national accounts. It would also allow for the integration of the interregional tables into recent global tables as well as for future analysis for more than one year once the 2015 tables have been constructed.

The complexity of this conversion is due to the large product and industry detail (350 x 140) and differences between national and regional accounts. For some large changes in the ESA 2010 (like the treatment of R&D) or the Belgian national accounts (incl. a revision of the Nace attribution) specific adjustments have been made to the regional tables. Most of the adjustments are automatic, though. The automatic adjustment is set up as a recursive process, using the interregional use table at basic prices and the supply tables of the three regions as a starting point. Each step consists of a series of RAS procedures by industry or final demand component for adjusting towards new regional and national totals. The problem of zero values in the interregional SUT (while not in the new national table) is also addressed.

From Supply and Use Tables to Social Accounting Matrices for India: A Synthesis of Methodologies

Topic: IO Data: IO and micro data
Author: Anuradha Venkatesh
Co-Authors: Barun Deb Pal

We contribute to India's macroeconomic database of Input-Output Tables (IOTs) and Social Accounting Matrices (SAMs) by compiling tables for an updated base year. Our methodology is a synthesis of national and global compilation techniques. Although existing approaches conform to the System of National Accounts (SNA), a convergence has not been established in the Indian context. Revisiting these methods using a common I-O table will help establish consistency among databases and provide methodological insights. The Central Statistics Office (CSO) of the Government of India has been regularly publishing IOTs since the 1960s. The latest table was published in 2012 for the reference year 2007-08. Although a Supply and Use Table (SUT) is available for 2012-13, a corresponding IOT has not been presented thus far. Given their significance in understanding complex inter-relationships within economies, it is imperative that they are regularly made available to practitioners in the field. In this study, we synthesise methodologies described in the Eurostat Manual on Input-Output Tables and the CSO's latest publications to construct a symmetric I-O flow matrix from supply, absorption and make matrices. A 140 x 140 commodity matrix comprises a uniquely detailed database, useful to practitioners and policy makers alike. We also compile satellite accounts, namely, an investment and labour matrix. Since the government has not published them for several years, we develop a methodology to undertake their construction. In addition, this study enriches India's anthology of SAMs by compiling a disaggregated matrix of 140 sectors. The SAM takes into account gender, regional and skill-wise differences in labour. Further, it classifies households according to region and income deciles. Such extensive databases find important applications in a wide range of macroeconomic policy analyses, and provide the foundation for computable general equilibrium modelling.

Keywords
Input-output flow matrix, social accounting matrix, satellite accounts, supply and use tables, database creation, compilation, methodology, national accounts, macroeconomics

A detailed regional household carbon footprint analysis using expenditure accounts

Topic: Classical IO applications: Industrial economics, Productivity and Efficiency
Author: An VERCALSTEREN
Co-Authors: Koen Breemersch, Maarten Christis

Households are responsible for the bulk of the overall direct and indirect emissions of the carbon footprint of nations. Additionally, variation across different household characteristics (e.g. size, income, age) leads to differing consumption patterns between individual households. In combatting climate change, policy is thus challenged to account for these differences.
We analyzed, for the regional case of Flanders (Belgium), which socio-economic household characteristics are associated with a higher than average per capita carbon footprint and which consumption domains trigger this higher than average carbon footprint. To obtain a better estimate of direct and indirect emissions we draw upon the EXIOBASE multi-region input-output dataset combined with regional input-output data and detailed regional household budget survey

data.

Our analysis shows that the decomposition of the carbon footprint into the relevant consumption domains reveals insights that are absent when comparing only total carbon footprints between different types of households. Overall we find that there is a clear link between the income distribution and the carbon footprint of consumption, a finding that returns frequently in literature for both developed and developing countries. However, this income distribution is closely related to several underlying other socio-economic categories (e.g. level of education and household size) which do provide further insights useful for policy as they reveal important socio-economic aspect which needs to be considered.

During the presentation we will present the results and give insights in the quantitative assessment of the regional household carbon footprint analysis using expenditure accounts and input-output analysis. The observed trends in the carbon footprint related to the different socio-economic characteristics of households will be discussed.

Modelling the regional labour market for midwives in Denmark with LINE, an interregional SAM-type 2-by-2-by-2 principle model

Topic: IO modeling: Computable General Equilibrium Modeling and Social Accounting Matrices
Author: Laura Maria Virtanen
Co-Authors: Bjarne Hartz Madsen

The Capital Region of Denmark has the highest share of inhabitants between the age of 20 and 35 in all of Denmark, representing about 24% of the total population in the region in 2016. In addition, the number of births in the Capital Region are expected to grow by 22% between 2016 and 2030. This is likely to have direct effects on the demand for midwives, gynecologists, obstetricians and pediatric specialists. Currently, there is a relatively balanced labour market for midwives in the Capital Region of Denmark. However, will the stock of qualified midwives be enough to meet higher demand in the future? How many more midwives will there be necessary to educate in order to retain a balanced labour market going out to 2035?

In order to assess the demand and supply of labor with educational qualifications in midwifery, the health version of the Local Interregional Economic model for Danish municipalities LINE has been used. The health version of LINE includes several model extensions, including an extended stock-flow demographic sub-model, a sub-model for the demand for individual governmental consumption, as well as the labour market sub-model. In order to accurately forecast the supply health care personnel, an education-graduation sub-model has been imbedded into the demographic model. For the sake of this paper, only the labour market for midwives is considered.

As reported by the Danish Ministry of Higher Education and Science, the educational capacity for midwives increased by 30 additional seats in 2018 in The Capital Region of Denmark. As an alternative scenario, this effect has been manually included in the in the model as a one-off increase of 30 additional admissions into the midwifery program. A forecast of this scenario, representing the consequences on demand and supply of labour with midwifery education, is presented.

Multiregional economic impacts of renewable energy adoption in the United States using Industrial Ecology Virtual Laboratory

Topic: Multi Regional Input-Output (MRIO) Models Using Industrial Ecology Virtual Laboratory: Development of Regional IE Lab models and Applications
Author: Venkata Sai Gargeya Vunnava
Co-Authors: Futu FATURAY, Manfred LENZEN, Shweta Singh

The share of wind energy in the US energy supply has been steadily increasing in the last two decades. With new wind energy farms being installed in various states of the country, local and multi-regional economic disruptions are bound to take place. The multi-regional economic impacts of installing new wind farms was determined using the Industrial Ecology Virtual Laboratory (IELab). Recently, a US-MRIO (Multi-Regional Input-Output) model has been developed in IE lab. The economic impacts were calculated by feeding IELab the value added and change in final demand obtained from the Jobs and Economic Development Impacts (JEDI) Wind model published by National Renewable Energy Laboratory (NREL) in the US. The JEDI wind model provides the change in local economic data such as the number of new jobs created, increase in the final demand of a product in each region, etc. The JEDI wind model only gives the local data and does not account for the multi-regional economic disruptions that take place due to changes in final demand in a particular region under study. The economic impacts were studied for the top 10 wind energy producing states in the US and the year of wind farm installing was set to 2018. The overall national economic disruptions due to installing new wind turbines in these 10 states were analyzed.

Development of a city-level multi-regional input output database for sustainable city management in Japan

Topic: Environment-Extended IO Analysis at City Level
Author: Takako WAKIYAMA
Co-Authors: Manfred LENZEN, Keisuke NANSAI

Development of a city-level multi-regional input output database for sustainable city management in Japan

Takako WAKIYAMA1,2, Manfred LENZEN1, Keisuke NANSAI1,3, Ryosuke BAMBA4

1. ISA, School of Physics, University of Sydney, Australia
2. Institute for Global Environment Strategies (IGES), Japan
3. Center for Waste Management and Material Cycles Research, National Institute for Environmental Studies, Japan
4. Environmental Systems Engineering, Ritsumeikan University, Japan

Resource and environmental management are global issues recognised in Target 12.2 of the SDGs). At the same time, they are also local issues as resources are used in municipalities where factories and industries are located, and consumed mainly in cities where urban development occurs to accommodate growing populations. Targets 11.a and 11.b of the SDGs also clearly mention the importance of 'adopting and implementing integrated policies and plans towards resource efficiency, mitigation and adaptation to climate change and resilience to disasters'.

In order to improve the quality of city environments, enhance development planning capabilities

at the municipality level, and adequately respond to potential disasters, practical approaches to assessing economic, environmental and social impacts of urban development or potential disasters must be made available to researchers and policy-makers. These approaches should provide information at a holistic level, by including the city's resource and environmental hinterland, and by enabling municipal decision-makers to use them to react to challenges in a timely manner. To this end, we develop the Japan Industrial Ecology Laboratory (IELab), a detailed collaborative research platform that provides input-output-based analytical and decision tools, enabling users to investigate research questions on the nexus of sustainable development, resource use, urban planning, and supply-chain relationships connecting local municipalities with the rest of Japan. More specifically, we improve on existing time series of 47-prefecture multi-region input-output (MRIO) tables for Japan, by enabling MRIO analysis at the municipal level using the most up-to-date data sources, covering 4290 sectors at municipal level, for the 2005-2016 period.

Optimizing multi-regional production with economic-energy-environmental constraints in China

Topic: Thematic IO analysis: Disaster and Adaptation
Author: Ke Wang
Co-Authors: Jiayu Wang

Sustainable development has become a hot topic to integrating economic, energy, and environmental (E3) considerations. However, environmental emission due to the excessive use of fossil fuel is the biggest obstacle to achieve sustainable development. The Chinese government has promulgated series of policies on economic development, energy transition, and environmental protection and set corresponding targets, whereas a distinguishing feature of these decisions is the conflicts (trade-offs) between various objectives or priorities. Specifically, economic development leads to an increase of energy consumption and emissions, while energy conservation and emission reduction policies, in turn, may hinder economic growth. Therefore, in order to balance the conflicting objectives given the spatial heterogeneity in China, how to reallocate production among multi-regions and multi-sectors has become an important issue. Thus, compromise solutions are required to reconcile the competing goals. In this research, a multi-regional input-output (MRIO) based multi-objective programming model is proposed based on the MRIO dataset, taking into account the amount of utilized labor, energy, water resource, and emissions (4 air pollutions and 13 water pollutions). The model contains four competing goals, maximizing economic growth, and minimizing energy consumption, water use, and emissions, respectively. The model is applied to find a compromise composition of sectoral outputs of different provinces in Chinese economy. Results show that all the conflicting goals can be achieved through a compromise solution and thereby providing a provincial cooperation strategy related to reorganization of sectoral production structure to achieve common national goals. The marginal contribution of this research is that the national-level competing goals are reconciled through reallocation of provincial-level sectoral production. Additionally, multiple emissions are involved in this research. The framework proposed can be easily extended to search for E3 compromise solutions in other countries as long as the data is available.

City-level multi-regional input-output accounting using the IELab tool

Topic: Environment-Extended IO Analysis at City Level
Author: Yafei WANG
Co-Authors: Yafei Wang, Xuguang Song

The field of city-level carbon accounting is developing fast with several standards and many recent publications. Carbon accounting for cities is important and relevant for urban planning and policies related to energy, environment and trade, but so far no such a systematic tool for quantifying these relationships has been provided. This study provides a systematic and holistic tool i.e., city-level multi-regional input-output tables using Industrial Ecology Virtual Laboratory (IELab). First, a multi-regional input-output framework for cities is presented; Second, as much as possible city-level official input-output tables, census data, and macro-aggregates are collected and integrated into the city-level MRIOs; Finally, a typical MRIO table for Chinese capital cities are constructed to illustrate the carbon accounting at city level. This illustrates how mitigation is implemented in the real economic world through the appropriate city MRIO table.

A Dynamic Comparative Study on the International Linkage of China's Economic Growth under the New and Old Normal Situation -- Based on WIOT Analysis

Topic: DP2 Discussants: Peter McGregor, Jiemin Guo
Author: Wan Wei
Co-Authors: Jin FAN, Xiaohui YUAN

Abstract：The trade war between China and the United States has had a huge impact on the global economy. In fact, since China joined the WTO in 2002, the correlation between Chinese Economy and the world economy have continued to strengthen. We defined the period from 2002 to 2012 as the Old Normal, and China entered the New Normal after 2012. Based on the world input-output table from WIOD in 2002-2014,this paper studies and compares the evolution of the relationship between the economic growth of China in the Old and New Normal period and that of other regions in the world. The main research methods include: forward and backward spatial linkage coefficient; economic dependence; decomposition of value-added changes: value-added rate effect, domestic multiplier effect, feedback effect, spillover effect, domestic final product effect, overseas final product effect. The innovation of this paper : on one hand, using the MRIO model to analyze the power source of China's economic growth and the relationship between that and other economies in the world from the perspective of global linkage; on the other hand, conducting a dynamic comparative analysis of the International linkage changes in the Old and New Normal period. The main conclusions are as follows: Firstly, the forward linkage degree of China's secondary industry increased significantly in the Old Normal period, while that of the tertiary industry increased at a rapid speed after entering the New Normal. Secondly, the increase of China's external influence in the Old Normal period is mainly reflected in the large number of small and medium-sized developing economies, which has become more prominent since the New Normal. Thirdly, compared with Old Normal period, China's economy is more dependent on internal factors after entering the New Normal, among which the industrial sector's dependence on domestic final products has increased significantly.

Keywords: the New and Old Normal Situation, international linkage of economic growth, SDA,WIOT

Cross-border effects of climate change mitigation policies under different trade regimes

Topic: DP4 Discussants: Kirsten Wiebe, Shigemi Kagawa
Author: Kirsten S. WIEBE
Co-Authors: Moana SIMAS, Johannes TÖBBEN

In an increasingly globalized world, production chains are ever more fractioned across country borders, increasing the need to trace impacts of structural changes not only within the domestic economy, but also in other parts of the world. Decarbonizing the energy sector in one country can imply an increase in emissions in other countries due to increased production activities of certain technologies, or can create job losses in fossil fuel exporting countries. We implement the technological changes required for a 6-degree (increased mitigation action in the EU and Asia) and 2-degree (global climate mitigation action) warming scenario in a global multi-regional input-output system up to 2030. In light of SDG 13 "climate action", SDG 12 "responsible consumption and production", and SDG 8 "decent work and economic growth", we then analyze the indirect impacts on emissions, material extraction and employment through global value chains under four different trade scenarios based on the OECD "Scenarios for the World Economy". These scenarios are a baseline scenario, i.e. a continuation of current trends, an increased catch-up of the BRIICS countries, accelerated growth in the OECD countries, and decreasing trade openness. The corresponding trade structures at the product level are estimated using a gravity model. Preliminary results show that a global climate mitigation action scenario such as the 2-degree scenario, distributes positive effects on employment better around the world in an increased catch-up scenario, than in the other scenarios. The decreasing trade openness scenario puts most restrictions on the possibilities of climate mitigation action due to restricted access to raw materials.

The Paris Agreement and its effect on labor markets in Latin America and the Caribbean

Topic: Thematic IO analysis: Sustainable Development Goals / Developing countries
Author: Kirsten S. WIEBE
Co-Authors: Johannes TÖBBEN

The implementation of the Paris agreement will bring about significant structural changes in the global economy. Global multi-regional input-output (MRIO) databases paint a detailed picture of the current economic structure and trade dependencies between industries within and across countries [1]. Using these data as a base allows for a detailed modelling of the effects of the structural change that is necessary to reach the "less than 1.5 degrees warming" target. While the energy sector has to undergo the largest changes globally, for Latin-American and Caribbean (LAC) countries, the agriculture and forestry industries play an equally important role, both in the economy as well as for socio-economic and environmental consequences of the structural change.
The objective of this analysis is to quantify on a country-by-country basis the potential impacts of decarbonization strategies on labor in the LAC countries in the medium term (2030 and 2050). We use a simple input-output approach, based on data from GTAP9, with a modelling of technological change in the energy and the agricultural industries. We develop a set of simulations following the XLRM framework [2]: uncertainties (X), levers (L), relationships (R) and metrics (M). Uncertainty (X) relates to different possible future developments of exogenous factors, such as population, GDP per capita, total food intake per capita, and energy services

(electricity, transportation) needs per capita, and changes in demand outside the region. These uncertainties are applied to the different levers (L), i.e. the different possible technological developments. The resulting simulations with the MRIO table, which relates (R) the uncertainties to the levers, are analyzed with respect to three groups of metrics (M): direct and indirect employment, energy and food production, and emissions. These multiple combinations of the different uncertainties and levers allow us to estimate a bandwidth of possible outcomes for the effects of the Paris agreement on the different metrics in the LAC countries, thus quantifying possible uncertainties in the results of a simple IO simulation exercise. (We do not have any results yet.)

In addition to the analysis of the bandwidth of possible outcomes for the labor market in the LAC countries, we aim to develop a set of Python functions, that allow other IO researchers to easily implement the XLRM simulation analysis for different combinations of uncertainties and levers.

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[2] Kalra, N., Gill, S., Hallegatte, S., Brown, C., Fozzard, A., Lempert, R., Shah, A., 2014. Agreeing on robust decisions : new processes for decision making under deep uncertainty (No. WPS6906). The World Bank.

Allocating planetary boundaries to large economies: implications of different perspectives on distributive fairness and comparisons with current environmental footprints

Topic: Planetary Boundaries and IOA
Author: Harry C. Wilting
Co-Authors: Andries Hof, Paul Lucas, Detlef Van Vuuren

The planetary boundaries (PB) framework proposes global quantitative precautionary limits for human perturbation of nine critical Earth system processes, together defining a global safe operating space for human development. As decisions regarding environmental management and resource use are not made at the global scale, translating the global PBs to lower geographical scales is needed to increase their policy relevance. For climate change, many proposals for fair and equitable sharing of global emission reduction obligations (allocation approaches) have been presented and discussed in the literature. For other PBs, however, the discussion on allocation of global pressures or budgets is less developed. In this paper, we discuss national resource budgets for the PBs on climate change, land-system change, changes in biogeochemical flows (nitrogen and phosphorus) and biosphere integrity, for four large economies (EU , USA, China and India), using different allocation approaches. Furthermore, the allocated PBs are compared to current national environmental pressures and impacts from a consumption (footprint) perspective, using a multi-regional input-output (MRIO) model. Overall, except for the land-system change boundary, and the biodiversity loss boundary for India, current environmental pressures are above the allocated planetary boundaries in the four economies. While related reductions in environmental pressures or resource use are above the global average for the EU and the US, for China and India they are below the global average. The proposed methodology and results can help defining national policy targets in line with the global SDG ambition, building on the experiences and insights from climate change negotiations and the literature.

Of Yeast and Mushrooms: A comparison between TFP growth and hyper-integrated labour productivity changes

Topic: Classical IO applications: Industrial economics, Productivity and Efficiency
Author: Ariel Luis Wirkierman

Automation, machine learning and outsourcing are changing productive interactions across sectors and countries. When an algorithm learns by itself how to exploit new arbitrage opportunities, who should be rewarded with the additional value added or net product generated? How do our current frameworks to measure productivity changes in a multisectoral economy compare to each other and in what way do they capture (if they do) this changing nature of production?

The aim of this paper is to specify and compare (within a unified scheme) two frameworks for measuring productivity changes, rooted in the Input-Output tradition: Neoclassical TFP growth (Wolff, 1994; ten Raa, 2004) and Classical (vertically) hyper-integrated labour productivity growth (Pasinetti, 1981, 1988).

Departing from revenue-outlay relations, it is shown how TFP growth actually measures real cost reductions, i.e. profitability changes. In contrast, departing from expenditure relations, it is argued that total labour productivity indicators consistently capture the interdependent nature of volume changes in input use per unit of (subsystem) output. The former requires to adopt a price system for input aggregation, whereas the latter relies on defining an indispensable factor (labour) for the reduction of inputs and outputs in terms of factor content.

As volume productivity increases occur at the subsystem level whilst real cost reductions occur at the industry level, uneven sectoral patterns and effects of technical progress emerge. By adapting and implementing in a novel way the notion of 'Harberger diagram' (Harberger, 1998) to both measurement frameworks, the paper discusses the pervasiveness and unevenness (Inklaar and Timmer, 2007) of sectoral growth in profitability and productivity for a subset of national economies from the World Input-Output Database (WIOD), hinting at some (ongoing) changes in the nature of production.

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Abstract for INFORUM Organised Session (Demographic shifts and economic modelling): Detailed labour market modelling using the INFORUM model INFORGE

Topic: Demographic Shifts and Economic Modelling
Author: Marc Ingo Wolter
Co-Authors: Anke M. MOENNIG, Gerd Zika

Detailed labour market modelling using the INFORUM model INFORGE

Developments on the labour market are characterised by demographic shifts and technologically induced economic structural change, which is triggered by digitalisation. These changes on the labour market are examined in detail within the QuBe project (Qualifikation und Beschäftigung; engl.: qualification and occupation; www.qube-projekt.de) in order to derive specific recommendations for action or to show possible strategic directions to political actors.

The QuBe project is supported by the Federal Institute for Vocational Education and Training (BIBB), the Institute for Employment Research (IAB) and the Institute for Economic Structures Research (GWS) and is based on the macroeconometric INFORUM Input-Output model INFORGE (INterindustry FORecasting for GErmany), which has been developed by GWS and adopts a bottom-up modelling approach. Besides data input from the Federal Statistical Office, detailed data regarding the labour market supply on a disaggregated industry level in Germany (source: IAB) as well as the available education and qualification level(s) (source BIBB) are used within the INFORGE modelling. Thus, the QuBe project has led to a substantial extension of the GWS INFORUM-model INFORGE including an independent demographic projection, a detailed mapping of the education system and a comprehensive modelling of the labour market according to sectors and occupations. Meanwhile, the results of the QuBe project are also used by the Federal Ministry of Labour and Social Affairs (BMAS). Within this context, a special focus lies on the requirements for continuing vocational education.

The essential components of the macroeconometric model INFORGE including its extension Q(ualification)-INFORGE will be described: What are the requirements for the database? How are detailed labour market figures integrated into INFORGE modelling? Besides, resulting changes on the labour market and possible fitting problems will be discussed. Finally, the meaningfulness of INFORUM models along development paths will be presented by using the example of the construction industry.

Multipliers on trade - estimating a simplified SNAC for the EU

Topic: IO Data: Annual, Regional, and Multiregional Input-Output Accounts and Intra- and International Trade
Author: Richard WOOD

As research in the field of consumption based accounting has progressed a variety of input-output models global multi-regional input-output (MRIO) models have been developed and their data and capabilities have grown and improved. These global models are able to trace

environmental impacts through complex global supply chains, linking between production and consumption in different parts of the world. However, the difference in resultant environmental footprints between MRIO models and official national tables are due to the differing data used in official national tables. Here a SNAC-based approach is undertaken to remove this discrepancy, starting with the same derivation as for the domestic technology assumption, but replacing the assumption with data on the rest of world, rather than re-building a MRIO table. The basic principle follows the consideration of equivalency between the embodied impacts of each product in an IO table, no matter if they are destined for different consumers (e.g. for domestic or export markets). The approach is consistent with applying "life-cycle" approaches (as explained below) to the calculation of environmental footprints. The issue of double counting impacts embodied in traded goods is central here. These issues are discussed after introducing the mathematical framework first. An application is provided for the EU, showing a means to calculate updated environmental footprints, consistent with the EU SUTs without building a full MRIO model.

The carbon footprint of Chinese healthcare sector

Topic: Thematic IO analysis: Energy and Environment
Author: Rui Wu

Research question: Carbon footprint of healthcare sector is a key indicator for measuring and reducing the carbon emission stemming from healthcare service. In developed countries, carbon footprints of healthcare sector are estimated to be 3%–10% of the total national CO2 equivalent emissions. However, it remains unknown for developing countries. This study quantified the carbon footprint of Chinese healthcare sector and identified the major emission sources.
Method: We developed satellite account of CO2 emissions and did an environmentally extended input-output analysis of Chinese healthcare sector for the year 2012.
Data: We used the latest input-output table of China in 2012. The expenditure data were obtained from China Health and Family Planning Statistics Yearbook. The energy data of 45 sectors were obtained from China Energy Statistics Yearbook. For healthcare sector, the energy data were not available in the Yearbook and were indirectly obtained from the input from energy sectors to healthcare sector in input-output table.
Novelty: In developing countries, several studies estimated energy consumption or carbon emissions at hospital level but ignored the indirect energy use or carbon emissions of purchased medicines, medical instruments, etc. This is the first study to quantify both the direct and indirect carbon emissions of the entire healthcare sector in a developing country.

Carbon Emissions in GVC and Pollution Haven Hypothesis

Topic: China's (Inter)provincial Input- Output Tables: Applications and Advances
Author: Yan XIA

China's flourishing economic growth, increasing energy consumption and carbon emission has been extraordinary regional differentiation problem for structure of a nation's economy, physical geography, resource endowments, and other factors. The fragmentation of production across national and regional boundaries is a defining feature of the modern interregional economy. This calls for new measures to analyse trade patterns and embodied CO2 emissions in trade. As the McKerlie et al. (2006) suggest that all parties with a role in designing, selling or using a product are responsible for minimizing the environmental impact of the product over its life. A significant amount of emissions originates and flows between regions in the goods that are traded between

provinces, the embodied emissions in trade. Embodied emissions is a kind of concept used to examine the extent to which emissions are embodied in the interregional trade of goods and services (Wiedmann, 2008). If a country has to import a large amount of intermediate inputs to assemble its export products, the value added is much less than the gross exports value. In the end, it is the domestic emissions content in trade. In a hypothetical case, If cars are produced in two regions Guangdong and Shanghai. Guangdong sells cars to consumers in itself and in Yunnan. Shanghai's car industry sells on its domestic market and to export. Steel was produced in Yunnan then the emissions that went into producing that steel is typically attributed Yunnan. Perhaps a better way of accounting for the emissions is to attribute it to the province in which the car itself is consumed, at the source of demand, rather than that of supply. Therefore, how to estimate the embodied emissions in interregional trade is vertical to measure the domestic value chains and trade patterns.

In this paper, we outline two perspectives on the CO2 emissions content of interregional trade. We distinguish two perspectives: the bilateral trade perspective (BT) or direct trade flow (DTF) perspective, and the multi-lateral trade perspective (MT) or global value chain (GVC) perspective. We found that the BT perspective is useful to analyse the domestic embodied emissions content of exports or outflows. The MT perspective is useful for tracing the carbon footprints and the development of global value chains.

Results

First, there are three key trading blocks. The Central Region is the main embodied emissions exporter, with significant flows to the East and North Coasts, while the Southwest Region is the main supplier of embodied emissions to the South Coast provinces. A smaller trading bock exists in the north between the interior Northwest Region and the Northern Municipalities and Northeast. These distinct groupings reflect the regional characterization of internal trade within China, due to the limited transport infrastructure linking the country, combined with the distances involved.

Second, the bialateral perspectives require a split of the exports by region of destination but still do not require a multi-regional input-output table. To analyze the new trade patterns, we decompose emissions into tree components, a multi-regional input-output table is needed and some double-accounting pitfalls should be avoided.

Conclusions

We highlighted two perspectives on the CO2 emissions content of trade. Since both perspectives as generated in a region to trading partners and to itself, it is vertical that the input output data used to calculate the BT and MT contents accurately reflect domestic embodied emissions and their division over industries and regions. The MT perspective is useful when you want to know how much various regions contribute to the emissions of a particular product, like a car produced in China as it allows tracing the embodied emissions in all stages of production.

Global Cost Structure Analysis

Topic: IO Theory: Input-Output Price Model
Author: Takashi YAGI

The aim of this paper is to introduce a new analytical method of global cost structure. Home country imports goods produced in foreign countries which imports goods from home country. This means that some portion of imported goods are produced by means of domestic labour of home country. This paper aims to grasp real costs of domestic product by distinguishing the costs which should be attributed to home country from those attributed to foreign countries. The analytical method of our paper is the cost structure analysis originally introduced in Yagi (2017). The cost structure analysis of Yagi (2017) applied Sraffa's Standard system, which is defined by

the eigenvector and eigenvalue of the input coefficient matrix, to a non-competitive import type input-output table, and construct one dimensional theory of distribution. This paper explains how to apply the cost structure analysis of Yagi (2017) to the International Input-Output Table and calculate the global cost structure.
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ESTIMATING CARBON EMISSIONS EMBODIED IN FINAL DEMAND AND INTERNATIONAL GROSS TRADE USING THE OECD ICIO 2018

Topic: IO modeling: Consumption-based accounting
Author: Norihiko YAMANO
Co-Authors: Joaquim J.M. GUILHOTO

Earlier OECD studies on carbon footprint analyses taking into account for global production networks have contributed to increase awareness of divergences in territorial or production-based and consumption-based carbon emissions. The differences in these measures are essential for formulating responses to international climate change negotiations. This paper provides the latest estimates of demand-based carbon emissions of selected 65 economies for the period between 2005 and 2015 with a revised methodology of territorial and economic output-based emissions. Using the latest main data sources (2018 edition of the OECD Inter-Country Input-Output (ICIO) tables, the OECD Air Emissions Account under the System of Environmental-Economic Accounting (AEA-SEEA) and the IEA CO2 emissions from fuel combustion data), new estimates of emissions embodied in final demand and in international trade were generated using a more refined methodology than previous versions. Namely, following extensions are included: 1) explicit distinctions between territorial, economic output, final demand-based emissions as well as emissions embodied in gross imports and exports, 2) estimates by major fuel combustion sources, 3) fuel purchases by non-resident industries (road transportation; international aviation and marine bunkers) and household (motor vehicles fuels consumption abroad)

Potential environmental savings through food waste reductions: a new method

Topic: Thematic IO analysis: Environment
Author: Bingqian YAN
Co-Authors: Erik DIETZENBACHER, Bart LOS

About one-third of food produced for human consumption is lost or wasted globally. Besides food losses and waste itself, this also means that a significant amount of natural resources used for producing the lost and wasted food are wasted, and the associated greenhouse gas emissions are also emitted in vain. To accurately quantify the environmental saving through eliminating food losses and waste, this paper proposes a new method where the environmental savings are calculated as the environmental footprint difference between the original situation and the hypothetical situation where the food losses and waste are avoided. Our results show that 10.3% of the food products could be saved through eliminating food losses and wastes. Consequently, 2.7% of the GHG emissions, 8.1% of the land use, 4.6% of the material use, and 9.2% of the blue water use for satisfying household consumption could be saved. Food losses and wastes

elimination in North America& Oceania could achieve the largest environmental savings. This study can not only raise the public's awareness for eliminating food losses and waste, but also show that reducing food losses and waste is a cost-effective way to combat hunger and improve food security as well as protect the environment.

Extended Supply & Use Tables by Firm Heterogeneity: Methods and Applications for China

Topic: Compiling and Applying the APEC TiVA Database
Author: Cuihong YANG
Co-Authors: Yiying SHI, Rui WEI, Kunfu ZHU

Foreign invested enterprises (FIEs) and domestic owned firms (DOEs) are different in many aspects, such as production input, export pattern and impacts on the local country. For example, FIEs and DOEs play different roles in generating local value-added. A large part of value-added from global value chain in developing economies is generated by affiliates of multi-national enterprises (MNEs). Besides, FIEs and DOEs have different performance on technology dissemination and skill building. What's more, compared with DOEs, FIEs are more export-oriented. Therefore, firm heterogeneity should be reflected when compiling supply and use tables (SUTs) and input-output tables. Otherwise, the simple homogeneous assumption will cause biased estimation in many cases and thus mislead policy makers. Nowadays 12.7% of China's industrial enterprises above designated size are foreign invested enterprises which contribute 19.3% to total assets and 24.6% to total profits of industrial enterprises above designated size in 2017. So it's necessary for China to extend the Supply & Use Tables (and Input-Output Tables) by firm heterogeneity. At first we split the Input-Output tables by firm heterogeneity and construct the extended Supply Tables with FIEs and DOEs. Then based on the above extended tables, we calculate the extended use tables by firm heterogeneity under the commodity technology assumption. However, as for the case of China, there are many challenges for the compilation of SUTs with firm heterogeneity, such as the choice of basic statistical units, the challenging of basic prices, lack of data by ownership, etc. Given the SUTs compilation practice in China, this paper employs some methods to estimate SUTs with firm heterogeneity, and discusses the applicability and limitations of these methods.

Investigating double counting terms in the value-added decomposition of gross exports

Topic: Classical IO applications: Trade and GVCs
Author: Ming Ye
Co-Authors: Sebastien MIROUDOT

In the input-output framework, the concept of 'double counting' comes from the measurement of intermediate inputs. Output is equal to (domestic) value-added plus intermediate inputs. But intermediate inputs are also produced with (domestic or foreign) value-added and other intermediate inputs. Double counting terms can be regarded as a subset of intermediate inputs in output decomposition. When it comes to value-added in exports, there is no consensus yet on the definition of double counting terms. Some authors, such as Koopman et al. (2014), Nagengast and Stehrer (2016) and Borin and Mancini (2017) propose to base the definition on the number of international border crossings. Also, Los and Timmer (2018) point out that the double counted domestic value-added is the sum of the bilateral domestic value-added across all partners minus

the unilateral one (i.e. with partner world). Moreover, they indicate that the allocation of value-added to gross flows is 'arbitrary'. Alternatively, Miroudot and Ye (2018) rely on a supply-side input-output model. In their framework, double counting terms can be measured by the second and later input rounds in the generation of value-added in exported goods using the Ghosh decomposition.

In this paper, we investigate more closely the concept of 'double counting' in the decomposition of gross exports. First, we show that while domestic value-added can be indeed 'double counted' in the domestic content of exports, the concept of foreign double counting is more complicated and does not always imply value-added counted twice from the point of view of the exporting economy. When talking about 'double counting' in gross exports, it is important to distinguish the global level (world) from the country level. We provide separate frameworks and introduce different terms based on the global-consistency and country-consistency of the decomposition in order to shed light on the distribution of GDP in the global/country export flows. We thus clarify the meaning of double counting terms in the different decompositions of gross exports.

Winners and Losers in a Knowledge-based Economy: Investigating the Policy Packages for an Inclusive Growth based on a Computable General Equilibrium analysis of Korea

Topic: IO modeling: Econometric, CGE and SAM modelling
Author: Yeongjun Yeo

The intrinsic attributes of innovation can be summarized as "factor-biased technological progress". Firstly, technological innovation accompanies skill-biased technological change (SBTC), which can be described as a shift in the production technology that favors skilled over unskilled labor by increasing its productivity and therefore, its relative demand. Secondly, recent studies on the relationship between innovation and employment structure address that technological progress from innovation causes not only SBTC, but also capital-biased technological change. These intrinsic properties of technological progress have the potentials to deepen social inequalities and polarization by increasing economic returns to high-skilled workers and capitalists in the economic system. Especially, a growing body of recent studies has expressed concerns over the side effects caused by the factor-biased technological change, and propose a wide range of policies to address negative impacts from technological innovation. However, they are rather fragmented, and mostly limited to a single policy instrument. In addition, there has been a lack of quantitative studies on policy impact assessments.

The policy implications, in terms of employment and inequality challenges posed by technological innovations, can be summarized as the need to adopt a broad perspective when preparing policies dealing with these issues, rather than just focusing on a single policy instrument. In this spirit, we advocate that innovation policies should be accompanied by other complementary policies in order to counterbalance the negative impacts of factor-biased technological progress. The question is then how to formulate and coordinate policy options from various dimensions to achieve inclusive growth in the knowledge-based economy. Existing studies, however, often fall short of reflecting the concept of policy mixes, and seem insufficient to draw policy implications in practical senses. In this regard, the present study intends to bridge this gap in the literature.

Considering these limitations of previous studies, this study firstly aims to propose a conceptual framework to investigate the economy-wide impacts of factor-biased technological change and the role of policy packages to deal with this issue, by addressing the limitations of previous studies' approaches. Secondly, this study aims to quantitatively assess the macroeconomic impacts of policy packages consisting of innovation, education, and taxation policies to mitigate the structural problems caused by the factor-biased technological change based on the

Computable General Equilibrium (CGE) model. Throughout the study, this study aims to investigate and identify the potential roles of policy packages from several different dimensions (i.e., innovation, education, and fiscal policies) by examining the economy-wide impacts of the different types of policy mixes on the economic system based on CGE analysis so as to inform and advise policymakers in designing an appropriate policy package for inclusive growth. We focus on the economy in South Korea, and simulation results for policy scenarios are analyzed in terms of employment structure, economic growth, and income inequality. Our study is significant, in that it is devoted to a macroeconomic analysis in investigating the impacts of different types of policy mixes, and drawing upon policy implications addressing the complementarity of policy instruments. Ultimately, this study expects to shed light on the importance of the policy packages in resolving the side effects of factor-biased technological progress and spur the inclusive growth in the knowledge-based economy.

For the empirical analysis, this study aims to propose a knowledge-based CGE model by incorporating fowling key features: 1) endogenizing innovation-related elements considering the characteristics of knowledge (including, consideration of knowledge as a factor of production, endogenization of knowledge capital investments, and consideration of spillover effects coming from the knowledge accumulation), 2) endogenizing decision-making process on the human capital accumulation affected by the relative wages of workers and educational investments, 3) designing the endogenous interaction between innovation and human capital accumulation within the production function, 4) describing the intrinsic attributes of technological progress within the production structures, and 5) establishing the model to simultaneously estimate growth and distribution effects with considerations of heterogeneous labor and households within the equational systems and SAM. The economic intuition behind these methodological approaches is that dynamically changing endogenous interaction between the technological progress via innovation activities and human capital accumulation shapes the growth and distribution patterns of the economic system, through interactions with market mechanisms.

The methodology of compiling APECSUTs with discrepancies

Topic: Compiling and Applying the APEC TiVA Database
Author: Jianqin YUAN
Co-Authors: Yaxiong ZHANG

With the leadership of China and U.S and the collective effort of the 21 APEC economies, the official APEC TiVA database will be completed in the early 2019. It is the first official APEC database constructed in the framework of SUT and based on bottom-up approach with the participation of 21 APEC economies. This article describes the methodology and procedures on how to build APECSUTs with discrepancies based on official supply and use tables of 21 APEC economies. APECSUTs with discrepancies means the draft version of APECSUTs linked based on the international SUTs of each economy, and the trade flow in the APECSUTs SUT doesn't consistent with the trade data.

Firstly, official supply and use tables submitted by 21 APEC economies are adopted, however, at present, supply and use tables are not available for most APEC economies, so, the SUT furthers of APEC economies are discussed and the methodologies of estimating and updating, price adjustment and import use matrix compiling by different categories of basic data also be introduced. Then, the linking process of the APECSUTs are discussed. The APECSUTs are available for the 2005 and 2012 with 51 products and give the values of transactions among 34 industries in 20 economies plus the rest of the world and from these industries to households, governments and users of capital goods in the same set of economies. The article describes how information from the National Accounts, Supply and Use Tables and International Trade Statistics have been

harmonized, reconciled and used for estimation procedures to arrive at APECSUTs.

The Compilation Method of 2012 China's Multi-regional Input-output Model

Topic: IO Data: Annual, Regional, and Multiregional Input-Output Accounts and intra- and international Trade
Author: Jianqin YUAN
Co-Authors: Jifeng Li, Yaxiong ZHANG

With the constantly improving of marketization and the growing linkages between regions, the value-added distribution of regions in the industrial chain is constantly changing. It is not enough to accurately understand the characteristics of regional economy on the basis of the single administrative region. Therefore, the compilation of coordinated national, provincial and, in particular, inter-provincial input-output models has become a frontier method adopted by international organizations, governments and research institutions to do the regional researches. According to the error analysis of China multi-regional input-output models (CMRIO) in 2002 and 2007, it is found that the inconsistency between national and provincial tables is one of the main sources of the error. So, based on the national and 31 provincial input-output tables of 2012, firstly, this paper conducted a comparative analysis of the national and provincial tables from the perspectives of conceptual inconsistency, structural inconsistency and trade inconsistency to provide the basis for balancing and analyzing the error sources of CMRIO. Secondly, the improved Chenery-Moses model was adopted to estimate interregional trade flow and then the CMRIO model was developed. Finally, based on the CMRIO, the employment matrices of 31 provinces with 42 sectors and four types of labor force in 2012 were compiled. The results showed that most provinces had the largest proportion of agricultural labor force and rural non-agricultural labor force, while developed city, such as Beijing and Shanghai had the largest proportion of labor force with high or low skill in urban non-agricultural industries. Final consumption had the strongest pull on total employment, while exports had a weaker pull on employment than domestic demand. Finally, the degree to which the final demand of different industries drives the four types of labor force varies greatly.

The Social Footprint U.S. Multinationals' Foreign Affiliates

Topic: Firm Heterogeneity and Input-Output Analysis
Author: Jorge E. Zafrilla
Co-Authors: Ángela García-Alaminos, Mateo Ortiz, Guadalupe Arce

The success of the Sustainable Development Goals (SDG) requires the rethinking of some of our ethical principles as consumers and producers. There is a growing consumer consciousness-raising related to the transition towards a more socially inclusive economy. Since consumers are becoming citizens again, the more sustainable choices from the side of the consumer can enforce firms to comply with their corporate social responsibility targets. Specifically, multinational corporations, as one of the most powerful global institutions, have the chance to lead the transnational transition, it is time to walk the walk.
In this paper, we motivate a novel assessment of the social footprint of multinationals enterprises in the last years. Concretely, and considering that the United States (U.S.) is the country with the most and biggest multinational corporations around the world, this paper assesses the social footprint from the hosting country and consumer perspective of the U.S. multinational enterprises

foreign affiliates in the last years. The footprint is estimated using a socially-extended MRIO model based on the WIOD tables, combined with data of U.S. multinationals enterprises activity provided by the Bureau of Economic Analysis (BEA) in terms of value added generated by U.S. majority-owned affiliates around the world. The social extension relies on an own elaboration social database which comprises modern slavery indicators such as forced labor figures, bad labor indicators such as fatal and non-fatal injuries, and job's quality indicators such as temporary and part-time employment.

Should High Ratio of Domestic Value Added to Gross Exports be an Objective of Policy?——Based on China's Provincial Level Data

Topic: Classical IO applications: Trade and GVCs
Author: Hong Mei ZHANG
Co-Authors: Shantong LI, Jianwu HE, Lingxiu ZHU

As the division of labor of global value chain becomes an important form of global production, value added in trade can more accurately reflect trade gains than gross trade value. Many developing country policy-makers aspire to increase the ratio of domestic value added to gross exports (DVAR). However, whether high DVAR could be used as a policy objective remains to be studied. To study this, we use China provincial data to explore the relationship between the ratio of intra-provincial value added to gross exports (PVAR) and the development level, and compare the difference in PVARs of different province. The gross exports of 31 provinces and 14 sectors in China are decomposed into intra-provincial value added, other domestic provincial value added, foreign value added, and double counted terms based on the global Input-Output table embedded with China's most up-to-date provincial Multi-Regional Input-Output table for 2012 and the extended WWZ decomposition method.

This study gets the following four key findings. (1) There is a "U-shape" relationship between the PVARs of provinces and the provincial development levels. (2) There is a "U-shape" relationship between the PVARs of sectors with provincial development levels. (3) The PVAR for Agriculture, Industry and Services shows a "U-shape" difference; The PVAR of Agriculture and Services is relatively higher than that of Industry; The PVAR of labor-intensive manufacturing is higher than that of capital-intensive manufacturing which is higher than that of technology-intensive manufacturing. (4) With the effect of export structure, the province with higher development level may have lower PVAR.

These findings suggest that high PVAR cannot be separately used as an objective of policy. Development stage and structural characteristics of the provinces should also be considered to determine the direction and path of trade upgrading.

Technology-adjusted national carbon accounting for effective climate policy: from the perspective of vertical specialization

Topic: Thematic IO analysis: Energy and Environment
Author: Hongxia ZHANG
Co-Authors: Geoffrey J.D. HEWINGS, Chen LIN

A policy sensitive and effective green-house gas accounting method is very important for policy maker to allocate responsibilities for emissions. Both of the production- and consumption-based

accounting (PBA and CBA) have their shortages for the purpose. Thus technology adjusted accounting methods are proposed for effective climate policy making (Kander et al, 2015). Considering the production fragmentation and vertical specialization (shown by the continuous increasing of the intermediate trade) in combination with the various technology used in sectoral production, this paper proposes a new technology adjusted national carbon accounting method, from the perspective of vertical specialization. Interregional differences in sectoral carbon intensity, patterns of final international trade, and patterns of intermediate international trade are taken into consideration in our new accounting method. Moreover, our method satisfies the conditions of additivity, sensitivity and monotonicity, without additional conditions. The empirical study is based on World Input-Output Database (WIOD).

Employment of China's Industry with Heterogeneity by Firm Size

Topic: Firm Heterogeneity and Input-Output Analysis
Author: Junrong Zhang

With the rapid growth of China's economy, China has become one of the country with the largest population in the world, and China's employment problem has been widely concerned by scholars from all over the world. In recent years, the Chinese government has actively pursued various policies to promote the improvement of employment level. However, the firm is the carrier of employment personnel, and the implementation of various employment policies needs to rely on the specific implementation of micro-firms. Therefore, it is necessary to carry out employment policies from the firms level to solve the employment problem. Specifically, the rapid development of China's economy has bred a large number of small and medium sized firms these years, which have played a significant role in promoting the steady progress of China's economy. The data shows that China's small and medium sized enterprises have contributed 60% of China's GDP, 50% tax and 80% of urban employment in 2017. However, because of the advantages of large firms in capital, scale and other aspects, there are obvious differences among large, small and medium sized firm. Accordingly, there are significant differences in the production structure, technical level, import and export trade, employment, as well as the economic impact among firms of different size types. Under this background, it is of great significance to study the employment patterns of different size of firms, which contributes to study the strategy of China's employment. In this paper, we construct an input-output table considering the heterogeneity of firm size for the year 2012 in order to explore the value-added as well as employment by different sized firms in China. This study may provide some differentiated policy implications at firm level which can help to promote employment.

Remapping embodied carbon emissions in China's exports

Topic: DP1 Discussants: Joaquim Guilhoto, Anne Owen
Author: Zengkai Zhang
Co-Authors: Huiwen Liu, Jing MENG, HERAN ZHENG, Kunfu ZHU

A clear and exact picture of CO_2 emissions embodied in trade has significant policy implications, such as addressing responsibility-sharing in international climate negotiation. Embodied carbon in exports of China, the world's largest carbon emitter and largest export economy, has been a focus of both academic and political debates. This study calculates embodied CO_2 emissions in China's exports in 2012 based on an input-output technique approach that captures provincial differences in the production structure of ordinary and processing exports. We show that the

traditional calculation approach overestimates domestic emissions embodied in China's exports by 23.4% and underestimates embodied foreign emissions by -29.3%. The reason for the biased estimation mainly lies in a few coastal provinces and industry sectors. Distinguishing between ordinary and processing exports from these provinces and sectors therefore represents a potential solution to the biased estimation problem of embodied CO2 emissions in China's exports.

We first construct China's inter-province input-output table in 2012 that captures the spatial divergence in ordinary and processing exports in 30 provinces. This is the first database that presents the regional diversities in trade patterns at provincial level. Second, we embed the inter-province input-output table into inter-country input-output table obtained from WIOD. This dataset allows us to trace the sources and destinations of embodied CO2 emissions in provincial exports. Both domestic and foreign provinces' emissions may be embodied in China's exports, and the exported products may be absorbed by different countries or regions. The literature adopts input-output model, first proposed by Leontief, to trace sources and destinations of carbon transfer flow. Yet, the original Leontief insight is not sufficient to quantify the embodied emissions in exports at the bilateral level. This study adopts a bilateral trade accounting framework to traces carbon transfer flows that China's exports are engaged in.

Assessing the Energy, CO2 and Value Added Flows Embodied in the International Trade of BRICS - Based on a MRIO Model

Topic: Thematic IO analysis: Energy and Environment
Author: Zhonghua Zhang

The BRICS (Brazil, Russia, India, China and the South Africa) has been becoming an important contributor to the growth of world economy. Concerns of carbon emissions from the BRICS increasingly rises with its expanding energy use recently. Although the embodied energy use related emissions of the BRICS were greatly discussed in the literature, the integrated analysis on energy, carbon footprint and value added flows associated with the international trade for the BRICS has rarely studied to date. Based on an improved Multi-Regional Input-Output model, we analyzed the above-mentioned three flows embodied in the trades within the BRICS and between the BRICS and other economies. The main novelties of this research as follows. First, a new WIOD database was constructed by extracting South Africa out of the RoW following the consistent sector classification of the WIOD. Second, an improved extended MRIO model was developed to estimate embodied flows in trades of both intermediate use and the final demand. Last but not the least, results of this analysis are expected to fill the literature gap for a comprehensive understanding of embodied energy, CO2 and value added flows in the international trade of BRICS. The findings are valuable to policy formation on low carbon development for other emerging economies emulating such mode of growth under industrialization around the world.

A study on the restriction of water scarcity to the development of Beijing-Tianjin-Hebei urban agglomeration

Topic: Environment-Extended IO Analysis at City Level
Author: Zhuoying ZHANG
Co-Authors: Yuanjie Li, Minjun Shi

The Beijing-Tianjin-Hebei region (the BTH region) is a densely populated, economically developed and industrial-intensive region in Northern China and it is of an important strategic position in

National economic development. However, in the meantime, the BTH region is facing severe water scarcity which has been the foremost problem that constraints its development towards the world-class urban agglomeration. This study intends to provide a scientific assessment on the level of water scarcity in the cities of the BTH region and investigate its restriction to regional development through quantifying the economic loss caused by water scarcity.

Firstly, the scarcity of water for production of the 13 cities in the BTH region is evaluated by calculating shadow prices in the framework of input-output optimization. The water price is the marginal contribution of unit water resources to social and economic development in the optimized condition and it reflects the real value and the extent of water scarcity without administrative influences. The results show that the water scarcity reflected by shadow price has significant sectoral and regional heterogeneities in the BTH region. Southern Hebei is under the severest water scarcity and its water scarcity has been worsening during 2000-2016.Then the economic loss caused by water scarcity is obtained based on the comparison between the input-output optimizations with and without water constraint. The results indicate that cities in Hebei, especially in Southern Hebei, bear the highest economic loss due to water scarcity and thus the water scarcity in Southern Hebei should attach more attention. Besides, this study also points out that the water scarcity in the BTH region is underestimated by actual water price and the scarcity of agricultural water use in the BTH region is mostly underestimated. A rational pricing mechanism for agricultural water use properly reflecting water scarcity is recommended to be established to enhance water conservation in Hebei. The results of this study contribute to a deeper understanding on the restrictive impacts of water scarcity on regional development and can provide scientific references for relevant policymaking in the BTH region.

Carbon and Water Supply Chain in Urban Sustainability for North China Urban Agglomeration

Topic: Thematic IO analysis: Sustainable Development Goals / Developing countries
Author: HERAN ZHENG
Co-Authors: Dabo Guan, Jing MENG, Zhifu Mi

Urbanization has been booming at an unprecedented scale and rate, and this prosperity will continue. Global urbanization today has led to a range of concerns related to sustainability in different dimensions, scales, and fields, and global cities have come to play an indispensable role in sustainable development strategies. Recently, a new norm has emerged as urban agglomerations that cross city boundaries and encompass multiple urban areas. Urban agglomerations are expected to grow rapidly in both developed and developing countries. For example, there were 10 urban agglomerations with more than 10 million dwellers and 153 million people in 1990. By 2016, this figure rose to 31 urban agglomerations with a total population of 500 million; 24 of these agglomerations were located in the "Global South". By 2030, 41 urban agglomerations with 710 million residents are expected to exist.

In this study, we focus on the North China urban agglomeration (or Jing-Jin-Ji urban agglomeration), which is one of the largest urbanized regions but struggles with regional disparity and environmental issues. The carbon and water supply, demand and distribution in the lens of urban sustainability are discussed by illustrating carbon and water supply networks, which reflects the most important elements for sustaining urban growth. We then evaluate the pattern of cities' carbon and water networks in terms of potential efficiency and inequality. For our purpose, we develop a city-level multi-regional input-output dataset (MRIO) for 13 cities and 30 sectors in the urban agglomeration based on a regional input-output (IO) table, which is the first time a city-level MRIO table has been constructed.

Based on the city-level MRIO, we then apply an environmentally extended IO analysis (EEIOA) to account for the carbon and water footprint for each city by tracking carbon and water supply and demand. We show the concentrated pattern in both carbon and water supply chains from Hebei to Beijing and Tianjin, reflecting two megacities outstripping resources from the surrounding environment, and identify key supplier cities in the supply chain. The four industrial cities such as Shijiazhuang, Tangshan, Xingtai, and Handan contribute 66% of trade related carbon emissions, while The upstream water supply chain is mainly dominated by Baoding, Shijiazhuang, Xingtai, and Hengshui in terms of net flows and magnitude. However, the four cities are the most water-scarce cities; their per capita water resources are the lowest in the urban agglomeration. Of the total 1502 Mt of water embodied in net trade in the urban agglomeration in 2012, 68% (1025 Mt) is supplied by the most water-scarce cities.

Improving the efficiency of water and energy use is a core focus of sustainable development not only for water availability in arid regions but also for mitigation at the regional level. Unfortunately, carbon and water supply chains in the urban agglomeration are both inefficient, as cities with low efficiency undertake production activities for cities with higher efficiency. Meanwhile Carbon and water chains unveil the economic-environmental inequality in the urban agglomeration, of which Beijing and Tianjin are the largest beneficiaries. Identifying key sectors behind the carbon and water chain could help gain insights into the pattern.

The carbon supply chain in the urban agglomeration is largely shaped by heavy industrial production and energy generation. Half of the energy-related emissions are for construction and heavy industrial products, of which Shijiazhuang and Tangshan contribute the most, with 47% of construction-induced emissions and 40% of heavy industry-induced emissions. Beijing is responsible for 36% of construction-induced emissions, while other upstream cities, including many industrial cities, account for 30% of emissions embodied in energy for heavy industrial production. This indicates that the infrastructure (urban sprawl, highway construction) in these megacities, especially Beijing, largely shapes the patterns of the supply chain and that industrial cities, especially Tangshan and Shijiazhuang, play the supplier role. Thus, it highlights the city linkages between Beijing and Tangshan, Shijiazhuang should be paid more attention regarding sustainability policies on both the consumption and production sides.

In the water supply chain, agriculture plays a dominant role and consumes 2532 Mt of water for trade, accounting for 78% of the water embodied in trade, of which upstream cities take 75%. On the supply side, Shijiazhuang, Baoding and Xingtai are the largest agricultural water suppliers, contributing a total of 50% agriculture-related water. In contrast, more than 70% of agriculture-related water is demanded by the light industry and agriculture, which indicates that urban residents' daily life largely shapes the water supply chain.

The Entropy-based Chinese City-level MRIO Construction Framework

Topic: DP1 Discussants: Joaquim Guilhoto, Anne Owen
Author: HERAN ZHENG
Co-Authors: Dabo Guan, Jing MENG, Johannes TÖBBEN, Daoping Wang

Given the major part of the global population and economic activities in the city scale, understanding city's impacts within and out of boundary (e.g. spatial interdependence or connectedness of cities) has been becoming vital in policymakers at multiple levels, however, it is impossible without the rapid development of city-level MRIO databases. Unfortunately, current

MRIO databases focus more on the international level or subnational level. Lack of city-level MRIO databases has been compromising uprising city-level studies. Data availability is a key issue in city-level MRIO database construction, as city-level data are extremely scarce. Many efforts have been made to overcome the issue in city-level, in which IMPLAN and the Industrial Ecology Virtual Laboratory (IELab) technology are pioneers. The former is based on the double-constraint gravity model combined with data from the commodity flow survey by the US government. The latter overcomes these limitations and offers a flexible compilation structure for city-level MRIOs based on 11 non-survey methods and downscale from the superior table, such as the national IO table. Unfortunately, the former is still based on survey data that is not applicable in many other countries, while the latter largely follow a top-down philosophy with likely unrealistic assumption of homogeneity in technology and consumption between nations and regions. In this study, we propose a feasible bottom-up Chinese city-level MRIO construction framework, which is based on the entropy theory and publicly accessed data. It massively reduces the data requirement and can maintain data consistency without introducing uncertainty from balancing optimization.

We decompose the compilation processes into multiple layers. In the first step, the Provincial-level MRIO table would be constructed by using a total of 31 provinces official published single IOT, which would be served as a platform for the further city-level compilation. Cross-entropy is introduced in the trade data manipulation, as total domestic inflow and outflow for a sector are not the same when aggregating data from Province IO tables. Maximum-entropy is introduced in estimating interregional flows with survey-based transport data. In the second step, we begin city-level MRIO table construction by province with using adjusted province IO table (domestic trade adjusted in step 1). For a certain province, we first derive the city's output and value added for each sector (its classification is as same as the province IOT) from city's statistics yearbooks and international trade data from China customs database, which would be scaled to make sure the aggregated compatible with the accordingly data from province IOT. So, we are able to know the domestic supply for a sector for each city in the province. Then, the output of the key downstream sector and the city's population are used to do the regressions to estimate the total demand for the upstream sector for each city. Afterward, for a certain sector, maximum entropy would be introduced to estimate the local supply and demand, supply to cities within the province, demand from cities with the province, supply to cities out of the province in China, and demand from cities out of the province in China, with constraint from province IOT. These data would be further used in estimating inter-city trade flow for each sector by maximum entropy, and regionalization matrix. With estimated city-level trade data, we use cross-entropy to regionalise city-level IO table from Province IO table and transform it into non-competitive ones. Given the estimated intercity trade flow and city-level IO table, we are able to connect each city in a province by assuming each sector following the trade pattern. Because all the data are controlled in the whole steps, and compatible with each, there is no error in the city-level MRIO table in the province, which avoid the uncertainty introduced by optimization processes (e.g. RAS). The city-level MRIO table in one province would be inserted into provincial level MRIO table to replace the according province. Following the steps above, all the cities in China can be linked together.

To test the reliability, we make a comparison between city-level MRIO table in Hebei province compiled by this method and our city-level table in Hebei province complied previous based on the survey-based city IO table(only Hebei province have all city's IO tables). We found the main differences between the city-level MRIO table are the inter-city trade, which is largely because the aggregated trade in survey-based city IO tables has an incredibly large gap between the trade in province IO table. This framework or some techniques in the framework have strong potentials in applying all other countries.

Decomposing Domestic Value Added of Final Products: New Evidence from the ADB-MRIO

Topic: Classical IO applications: Trade, Outsourcing and GVCs
Author: Sheng Zhong

With economic interactions between nations rising strongly over past decades, production as well as consumption are taking place across sectoral and national borders through trade. This suggests international fragmentation of production chains in which each economy participates and adds value at each stage of production. In this paper, we provide some up-to-date macroeconomic evidence regarding the extent of international fragmentation and the driving factors. To do so, we derive the domestic value added share of final products for 2170 global value chains and 62 economies, and decompose the changes in economy-level domestic shares into five factors. Based on the new Asian Development Bank Input-Output tables (ADB-MRIO) for 62 economies between 2000 and 2017, we document a series of stylized facts. Across value chains and economies, domestic value added share has declined, indicating the pervasiveness of fragmentation. This process is driven by changing inter-industry production structure and trade structures in both intermediate production and final demand, while offset by changing value added share in output and final demand composition. Unlike most advanced economies, we find an increase in domestic shares in several emerging Asian economies (e.g., China) with a share-increasing trade structure effect in intermediate production, suggesting a production transition from advanced economies to these emerging Asian economies.

Consumption Pattern Change by Income Group and China's Economic Growth

Topic: Structural Change and Economic Growth
Author: Lingxiu ZHU
Co-Authors: Cuihong YANG

Investment-led, export-oriented way of development has led China's economy to achieve rapid growth in the past few decades but may not hold any more. Under the complex global economic environment, how to promote the driving force of household consumption to stimulate the economic growth is one particularly important issue at the present. Consumption pattern may differ by household income. However, in what way will the economic structure response to the changes in consumption pattern related with China's income distribution has not been investigated by now.

This study uses the data from the Chinese Household Income Project (CHIP) in 1995, 2002, 2007 and 2013 to analyze the relationship between income group and consumption pattern. In addition, we perform scenario analysis based on the input-output model to investigate the impact of changes in the income distribution on the structure of industry and employment. The results show that: (1) the income gap of Chinese households still exists, the most serious of which is the urban-rural one; (2) there is a significant dynamic relationship between income level and consumption pattern. The income gap is an important factor influencing the consumption pattern of Chinese households; (3) the result of different scenarios implies that the policy of reducing income gap will have an impact on the economic structure.

These findings suggest that stimulating the domestic demand should focus on upgrading of consumption pattern, especially of the lower income groups. Efforts should be made to increase

the income volume of the rural households so as to narrow the income gap between urban and rural areas.

Income distribution effects of Value Added Tax reform in China

Topic: IO Theory: Input-Output Price Model
Author: YE ZUOYI
Co-Authors: Kiyoshi FUJIKAWA

The value-added tax (VAT) is imposed to manufacturing sectors and business tax (retail sales tax) is charged to service sectors in China after 1994. This dual system, however, has been considered problematic from the point of view of complexity of tax system and inter-industry fairness of tax burden. Chinese government, therefore, has decided to abolish the business tax so that VAT may be also applied to service sectors. This tax reform has partially started on January 1, 2012, and fully started for all sectors in whole China on May 1, 2016.

This paper shows a model to express the price changes caused by value-added tax to apply the input-output price equilibrium model to China's non-competitive input-output table in 2012. On this basis, we analyze the effect of the tax policy of switching business tax to value-added tax on prices, tax burden and income distribution for China's households.

The results show that this tax reform may generally make the price decline and reduce tax burden of households in China. We have observed, however, the tax reform would have a stronger regressive and higher income person friendly feature than before the tax reform even though the tax reform would reduce tax burden for households of any income classes.

LIST OF AUTHORS

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BELEGRI-ROBOLI, ATHENA	NATIONAL TECHNICAL UNIVERSITY OF ATHENS, GREECE	
BERGLUND, MÅRTEN	GLOBAL ENERGY SYSTEMS, DEPT. OF PHYSICS AND ASTRONOMY, UPPSALA UNIVERSITY, SWEDEN	
BIERITZ, LORETO	GWS MBH (INSTITUTE OF ECONOMIC STRUCTURES RESEARCH), GERMANY	
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DERIU, STEFANO	DEPARTMENT OF ECONOMICS AND LAW - UNIVERSITY OF MACERATA, ITALY	
DIAS, ANA	GENERAL SECRETARY OF THE MINISTRY OF ENVIRONMENT AND ENERGY TRANSITION- PORTUGAL, PORTUGAL	Parallel Session 1, Conference Room 5 (Level 3)
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HAGINO, SATORU	FUKUYAMA UNIVERSITY, JAPAN	
HAMBŸE, CAROLINE	FEDERAL PLANNING BUREAU, BELGIUM	
HANAKA, TESSHU	DEPARTMENT OF INFORMATION AND SYSTEM ENGINEERING, FACULTY OF SCIENCE AND ENGINEERING, CHUO UNIVERSITY, JAPAN	
HARTONO, DJONI	UNIVERSITAS INDONESIA, INDONESIA	Parallel Session 2, Conference Room 3 (Level 3)
HASTUTI, SASMITA	UNIVERSITAS INDONESIA, INDONESIA	
HE, HE	UNIVERSITY OF SOUTH AUSTRALIA, AUSTRALIA	Parallel Session 1, Conference Room 6 (Level 3)
HE, JIANWU	DEVELOPMENT RESEARCH CENTER, THE STATE COUNCIL, CHINA, CHINA	
HE, JING	BEIJING UNIVERSITY OF CHINESE MEDICINE, CHINA	
HE, JING	UNIVERSITY OF CHINESE ACADEMY OF SCIENCES, CHINA	
HEIHSEL, MICHAEL	TECHNISCHE UNIVERSITÄT BERLIN / THE UNIVERSITY OF SYDNEY, GERMANY	Parallel Session 7, Conference Room 2 (Level 3)
HERTVELDT, BART	FEDERAL PLANNING BUREAU, BELGIUM	
HEWINGS, GEOFFREY	UNIVERSITY OF ILLINOIS, UNITED STATES	Parallel Session 6, Conference Room 7 (Level 3)
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HOOPER, TARA	PLYMOUTH MARINE LABORATORY, UNITED KINGDOM	
HOWELLS, THOMAS	BUREAU OF ECONOMIC ANALYSIS, UNITED STATES	
HSING-CHUN, LIN	DEPT. APPLIED ECONOMICS, NATIONAL CHIAYI UNIVERSITY, TAIWAN	
HSU, SHIH-HSUN	NATIONAL TAIWAN UNIVERSITY, TAIWAN	Parallel Session 4, Conference Room 2 (Level 3)
HUANG, MICHAEL	GRIPS, JAPAN	
HUANG, YONGMING	INSTITUTE FOR DEVELOPMENT OF CENTRAL CHINA, WUHAN UNIVERSITY, CHINA	
IMANSYAH, MUHAMMAD	LAMBUNG MANGKURAT UNIVERSITY, INDONESIA	
INFANTINO, GIANCARLO	UNIVERSITY OF MACERATA, ITALY	Parallel Session 9, Conference Room 5 (Level 3)
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JAHN, MALTE	HAMBURG INSITUTE OF INTERNATIONAL ECONOMICS (HWWI), GERMANY	
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JIANG, QINGYAN	ACADEMY OF MATHEMATICS AND SYSTEMS SCIENCE, CAS, CHINA	Parallel Session 4, Conference Room 6 (Level 3)
JIANG, XIAO	DENISON UNIVERSITY, UNITED STATES	Parallel Session 1, Conference Room 4 (Level 3)
JIANG, XUEMEI	CAPITAL UNIVERSITY OF ECONOMICS AND BUSINESS, BEIJING, CHINA, CHINA	
JIMÉNEZ, SOFÍA	ZARAGOZA UNIVERSITY, SPAIN	Parallel Session 1, Conference Room 8 (Level 3)
JIN, JIAN	WASEDA UNIVERSITY, JAPAN	
JONES, LIN	U.S. INTERNATIONAL TRADE COMMISSION, UNITED STATES	Parallel Session 8, Conference Room 4 (Level 3)
JOSHI, SURABHI	REGULATORY ASSISTANCE PROJECT (USA) AT MUMBAI, INDIA	Parallel Session 7, Conference Room 8 (Level 3)
JUNQUEIRA, TASSIA	BRAZILIAN BIOETHANOL SCIENCE AND TECHNOLOGY LABORATORY (CTBE/CNPEM), BRAZIL	
KAGAWA, SHIGEMI	KYUSHU UNIVERSITY, JAPAN	
KAMBLE, UJWALA	TATA SERVICES LIMITED, INDIA	Parallel Session 2, Conference Room 5 (Level 3)
KANEKO, MITSUKI	KYUSHU UNIVERSITY, JAPAN	Parallel Session 7, Conference Room 6 (Level 3)
KANEMOTO, KEIICHIRO	RESEARCH INSTITUTE FOR HUMANITY AND NATURE, JAPAN	Parallel Session 5, Conference Room 8 (Level 3) Parallel Session 8, Conference Room 3 (Level 3)
KANG, NING	GUIYANG MEDICAL COLLEGE, CHINA	Parallel Session 4, Conference Room 4 (Level 3)
KANGXIAN, JI	SCHOOL OF ECONOMICS AND MANAGEMENT,UNIVERSITY OF CHINESE ACADEMY OF SCIENCES, CHINA	Parallel Session 7, Conference Room 1 (Level 3)
KATRIS, ANTONIOS	CENTRE FOR ENERGY POLICY, UNIVERSITY OF STRATHCLYDE, UNITED KINGDOM	Parallel Session 5, Conference Room 2 (Level 3)
KAVESE, KAMBALE	ECSECC, SOUTH AFRICA	
KHAN, JAMAL	INSTITUTE FOR THE DEVELOPMENT OF CENTRAL CHINA, WUHAN UNIVERSITY, CHINA, CHINA	
KHAN, MUHAMMAD	COMSATS UNIVERSITY, PARK ROAD, TARLAI KALAN ISLAMABAD, PAKISTAN	Parallel Session 1, Level 1 Auditorium
KIM, JIYOUNG	OKAYAMA UNIVERSITY, JAPAN	Parallel Session 6, Conference Room 5 (Level 3)
KIM, KWANG	KYOTO UNIVERSITY, JAPAN	Parallel Session 4, Conference Room 8 (Level 3)
KIRCHNER, MATHIAS	AUSTRIAN INSTITUTE OF ECONOMIC RESEARCH (WIFO), AUSTRIA	
KITO, MINAMI	KYUSHU UNIVERSITY, JAPAN	Parallel Session 9, Conference Room 2 (Level 3)
KITSOS, TASOS	CITY-REDI, UNIVERSITY OF BIRMINGHAM, UNITED KINGDOM	Parallel Session 9, Conference Room 6 (Level 3)
KOLLER, WOLFGANG	INSTITUTE FOR INDUSTRIAL RESEARCH, AUSTRIA	
KOLPAKOV, ANDREY	RAS INSTITUTE OF ECONOMIC FORECASTING, RUSSIAN	
KONDO, YASUSHI	WASEDA UNIVERSITY, JAPAN	Parallel Session 5, Conference Room 8 (Level 3)
KONSTANTAKIS, KONSTANTINOS	NATIONAL TECHNICAL UNIVERSITY OF ATHENS, GREECE	
KRATENA, KURT	CESAR - CENTRE OF ECONOMIC SCENARIO ANALYSIS AND RESEARCH, SPAIN	Parallel Session 6, Conference Room 7 (Level 3)
KREPSKY, CAMILA	UFRJ - UNIVERSIDADE FEDERAL DO RIO DE JANEIRO, BRAZIL	Parallel Session 9, Conference Room 6 (Level 3)
KRONENBERG, TOBIAS	BOCHUM UNIVERSITY OF APPLIED SCIENCES, GERMANY	Parallel Session 7, Conference Room 7 (Level 3)
KUBONIWA, MASAAKI	HITOTSUBASHI UNIVERSITY, JAPAN	
KURODA, MASAHIRO	CENTER OF RESEARCH AND DEVELOPMENT STRATEGY, SCIREX CENTER, GRIPS, JAPAN	Parallel Session 9, Conference Room 8 (Level 3)

FULL NAME	INSTITUTION, COUNTRY	CONFERENCE PRESENCE
LA MARCA, MASSIMILIANO	INTERNATIONAL LABOUR ORGANISATION, SWITZERLAND	Parallel Session 1, Conference Room 4 (Level 3)
LÁBAJ, MARTIN	UNIVERSITY OF ECONOMICS IN BRATISLAVA, SLOVAK REPUBLIC	
LACH, ŁUKASZ	AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY IN CRACOW, POLAND	
LAHR, MICHAEL	RUTGERS, THE STATE UNIVERSITY OF NEW JERSEY, UNITED STATES	Parallel Session 6, Level 9 - Executive Room A
LAM, KA LEUNG	DELFT UNIVERSITY OF TECHNOLOGY, NETHERLANDS	Parallel Session 7, Conference Room 2 (Level 3)
LANE, JOE	UNIVERSITY OF QUEENSLAND, AUSTRALIA	
LANGARITA, RAQUEL	UNIVERSITY OF LA RIOJA, SPAIN	Parallel Session 8, Conference Room 2 (Level 3)
LATORRE, MARIA	UNIVERSIDAD COMPLUTENSE DE MADRID, SPAIN	Parallel Session 5, Conference Room 3 (Level 3)
LAWLEY, JOSEPH	UNIVERSITY OF LEEDS, UNITED KINGDOM	Parallel Session 5, Conference Room 4 (Level 3)
LECCA, PATRIZIO	FRASER OF ALLANDER INSTITUTE, UNIVERSITY OF STRATHCLYDE, UNITED KINGDOM	
LECHON, YOLANDA	CIEMAT, SPAIN	
LEHR, ULRIKE	GESELLSCHAFT FÜR WIRTSCHAFTLICHE STRUKTURFORSCHUNG MBH, GERMANY	
LEITE, FABRÍCIO	UFRN, BRAZIL	Parallel Session 7, Level 9 - Executive Room A
LENZEN, MANFRED	ISA, AUSTRALIA	
LEWNEY, RICHARD	CAMBRIDGE ECONOMETRICS, UNITED KINGDOM	Parallel Session 4, Conference Room 3 (Level 3) Parallel Session 6, Conference Room 1 (Level 3)
LI, JIFENG	STATE INFORMATION CENTER, CHINA	
LI, JING	CENTER FOR CENTRAL CHINA ECONOMIC DEVELOPMENT RESEARCH,NANCHANG UNIVERSITY, CHINA	Parallel Session 9, Level 1 Auditorium
LI, MO	UNSW SYDNEY, AUSTRALIA	Parallel Session 6, Conference Room 2 (Level 3)
LI, SHANTONG	DEVELOPMENT RESEARCH CENTER OF THE STATE COUNCIL, CHINA	
LI, XIUTING	UNIVERSITY OF CHINESE ACADEMY OF SCIENCES, CHINA	Parallel Session 5, Conference Room 7 (Level 3)
LI, YUANJIE	SCHOOL OF ECONOMICS AND MANAGEMENT, UNIVERSITY OF CHINESE ACADEMY OF SCIENCES, CHINA	
LILLIESTAM, JOHAN	ETH ZÜRICH, SWITZERLAND	
LIN, CHEN	SCHOOL OF ECONOMICS, RENMIN UNIVERSITY OF CHINA, CHINA	
LINDROOS, VILLE	STATISTICS FINLAND, FINLAND	Parallel Session 2, Level 1 Auditorium
LISENKOVA, KATERINA	UNIVERSITY OF STRATHCLYDE, UNITED KINGDOM	
LIU, FAN	UNIVERSITY OF CHINESE ACADEMY OF SCIENCES, CHINA	
LIU, HUIWEN	TIANJIN UNIVERSITY, CHINA	
LIU, LI	GUANGDONG UNIVERSITY OF FOREIGN STUDIES, CHINA	
LIU, SHUQIN	SCHOOL OF MANAGEMENT, MINZU UNIVERSITY OF CHINA, CHINA	
LIU, XIULI	CHINESE ACADEMY OF SCIENCES, CHINA	Parallel Session 8, Conference Room 6 (Level 3)
LÓPEZ, JUAN	UNIVERSIDAD CENTROAMERICANA, EL SALVADOR	Parallel Session 7, Level 9 - Executive Room A
LOPEZ, LUIS	UNIVERSIDAD DE CASTILLA-LA MANCHA, SPAIN	
LOPEZ, MERARIS	UNIVERSIDAD CENTROAMERICANA JOSÉ SIMEÓN CAÑAS AND TROPICAL AGRICULTURAL RESEARCH AND HIGHER EDUCATION CENTER, EL SALVADOR	Parallel Session 1, Level 9 - Executive Room A
LOPEZ-MORALES, CARLOS	EL COLEGIO DE MÉXICO, MEXICO	Parallel Session 5, Level 9 - Executive Room A

FULL NAME	INSTITUTION, COUNTRY	CONFERENCE PRESENCE
LOS, BART	UNIVERSITY OF GRONINGEN, NETHERLANDS	
LUCAS, PAUL	PBL NETHERLANDS ENVIRONMENTAL ASSESSMENT AGENCY, NETHERLANDS	
LUGOVOY, OLEG	EDF, RANEPA, UNITED STATES	Parallel Session 2, Conference Room 8 (Level 3)
LUTZ, CHRISTIAN	GESELLSCHAFT FÜR WIRTSCHAFTLICHE STRUKTURFORSCHUNG MBH, GERMANY	Parallel Session 6, Level 1 Auditorium Parallel Session 9, Level 9 - Executive Room B
MACIUNIAK, PABLO	C.H.U.I.M.I., SPAIN	
MADSEN, BJARNE	THE CAPITAL REGION OF DENMARK, DENMARK	
MAHLBERG, BERNHARD	INSTITUTE FOR INDUSTRIAL RESEARCH, AUSTRIA	
MAINAR CAUSAPÉ, ALFREDO	EUROPEAN COMMISSION. JOINT RESEARCH CENTRE-IPTS, SPAIN	Parallel Session 7, Conference Room 5 (Level 3)
MALIK, ARUNIMA	UNIVERSITY OF SYDNEY, AUSTRALIA	Parallel Session 1, Conference Room 7 (Level 3)
MANDRAS, GIOVANNI	JRC - EUROPEAN COMMISSION - SEVILLE, ITALY	Parallel Session 7, Level 1 Auditorium
MANGA, RUSHIL	NELSON MANDELA UNIVERSITY, SOUTH AFRICA	Parallel Session 2, Level 9 - Executive Room A
MANRIQUE DE LARA PEÑATE, CASIANO	UNIVERSITY OF LAS PALMAS DE GC (ULPGC), SPAIN	Parallel Session 2, Conference Room 1 (Level 3)
MÁRIA, FORGON	HUNGARIAN CENTRAL STATISTICAL OFFICE, HUNGARY	Parallel Session 7, Conference Room 3 (Level 3)
MARINOS, THEOCHARIS	NATIONAL TECHNICAL UNIVERSITY OF ATHENS, GREECE	
MARKAKI, MARIA	TECHNOLOGICAL EDUCATIONAL INSTITUTE OF CRETE, GREECE	Parallel Session 6, Level 9 - Executive Room A
MÁRQUEZ LLABRES, LUIS	ULPGC SERVICIO CANARIO DE LA SALUD, SPAIN	
MARSH, RICHARD	4-CONSULTING, UNITED KINGDOM	Parallel Session 8, Level 9 - Executive Room B
MARTINS FERREIRA, PEDRO	EUROSTAT, EUROPEAN COMMISSION, LUXEMBOURG	Parallel Session 7, Conference Room 3 (Level 3)
MASE, TAKAYUKI	CENTRAL RESEARCH INSTITUTE OF ELECTRIC POWER INDUSTRY, JAPAN	Parallel Session 8, Conference Room 8 (Level 3)
MATSUMOTO, KENICHI	NAGASAKI UNIVERSITY, JAPAN	
MCDONALD, SCOTT	HUMBOLDT UNIVERSITY OF BERLIN, UNITED KINGDOM	
MCDOUGALL, ROBERT	PURDUE UNIVERSITY, UNITED STATES	
MCGRANE, SCOTT	UNIVERSITY OF STRATHCLYDE, UNITED KINGDOM	
MCGREGOR, PETER	UNIVERSITY OF STRATHCLYDE, UNITED KINGDOM	Parallel Session 5, Auditorium A
MEADE, DOUGLAS	INFORUM/UNIVERSITY OF MARYLAND, UNITED STATES	Parallel Session 4, Conference Room 2 (Level 3)
MEHRA, SAHIL	SOUTH ASIAN UNIVERSITY, INDIA	Parallel Session 3 - Development Programme, Level 1 Auditorium
MENG, JING	UNIVERSITY OF CAMBRIDGE, UNITED KINGDOM	
MERCURE, JEAN-FRANCOIS	UNIVERSITY OF EXETER, UNITED KINGDOM	Parallel Session 6, Conference Room 1 (Level 3)
MEYER, MARK	INSTITUTE OF ECONOMIC STRUCTURES RESEARCH (GWS), GERMANY	
MI, ZHIFU	UNIVERSITY COLLEGE LONDON, UNITED KINGDOM	
MICHAELIDES, PANAYOTIS	NATIONAL TECHNICAL UNIVERSITY OF ATHENS, GREECE	
MICHEL, BERNHARD	FEDERAL PLANNING BUREAU, BELGIUM	Parallel Session 7, Conference Room 3 (Level 3)
MIROUDOT, SEBASTIEN	OECD, FRANCE	
MITOMA, HARUKA	KYUSHU UNIVERSITY, JAPAN	Parallel Session 2, Conference Room 3 (Level 3)
MOENNIG, ANKE	INSTITUTE FOR ECONOMIC STRUCTURES RESEARCH - GWS, GERMANY	Parallel Session 1, Conference Room 6 (Level 3)
MONSALVE, FABIO	UNIVERSITY OF CASTILLA-LA MANCHA, SPAIN	
MONTEIRO, ROBERTO	SENAI CIMATEC, BRAZIL	
MORENO REYES, EDUARDO	NATIONAL AUTONOMOUS UNIVERSITY OF MEXICO, MEXICO	Parallel Session 9, Conference Room 8 (Level 3)

FULL NAME	INSTITUTION, COUNTRY	CONFERENCE PRESENCE
MOTORIN, VLADIMIR	HIGHER SCHOOL OF ECONOMICS, RUSSIAN	Parallel Session 2, Conference Room 8 (Level 3)
MUKHOPADHYAY, KAKALI	MCGILL UNIVERSITY, CANADA	Parallel Session 4, Conference Room 6 (Level 3) Parallel Session 5, Level 9 - Executive Room A Parallel Session 6, Conference Room 4 (Level 3)
MURADOV, KIRILL	CENTRE FOR INFORMATION AND ANALYSIS OF FOREIGN TRADE (MOSCOW), RUSSIAN	Parallel Session 8, Conference Room 1 (Level 3)
NAEEM, KHANSA	COMSAT UNIVERSITY ISLAMABAD, PAKISTAN	Parallel Session 4, Conference Room 6 (Level 3)
NAGASHIMA, FUMIYA	KYUSHU UNIVERSITY, JAPAN	
NAKAMOTO, YUYA	KYUSHU UNIVERSITY, JAPAN	Parallel Session 7, Conference Room 6 (Level 3)
NAKANO, SATOSHI	THE JAPAN INSTITUTE FOR LABOUR POLICY AND TRAINING, JAPAN	
NANSAI, KEISUKE	NAT. INST. FOR ENV. STUDIES (NIES), JAPAN	
NIK RAMZI SHAH, NIK ROZELIN	UNIVERSITI PUTRA MALAYSIA, MALAYSIA	Parallel Session 1, Conference Room 3 (Level 3)
NISHIMURA, KAZUHIKO	NIHON FUKUSHI UNIVERSITY, JAPAN	Parallel Session 8, Conference Room 3 (Level 3)
NORAZMAN, UMI	UNIVERSITI PUTRA MALAYSIA, MALAYSIA	Parallel Session 8, Level 1 Auditorium
NTEMA, NICHO	INDEPENDENT, SOUTH AFRICA	Parallel Session 8, Level 9 - Executive Room B
OBERHOFER, HARALD	VIENNA UNIVERSITY OF ECONOMICS AND BUSINESS, AUSTRIA	Parallel Session 5, Conference Room 3 (Level 3)
OKAMOTO, NOBUHIRO	DAITO BUNKA UNIVERSITY, JAPAN	Parallel Session 2, Conference Room 2 (Level 3)
OLEKSEYUK, ZORYANA	GERMAN DEVELOPMENT INSTITUTE / DEUTSCHES INSTITUT FÜR ENTWICKLUNGSPOLITIK (DIE), GERMANY	
OLIVEIRA, CASSIUS	UNIVERSIDADE FEDERAL DO RIO GRANDE (FURG), BRAZIL	
OLIVEIRA, GILCA	UFBA - UNIVERSIDADE FEDERAL DA BAHIA, BRAZIL	
OLIVOS, PABLO	UNIVERSITY OF CASTILLA LA MANCHA, SPAIN	
OOSTERHAVEN, JAN	UNIVERSITY OF GRONINGEN, NETHERLANDS	Parallel Session 1, Conference Room 5 (Level 3)
ORTIZ, MATEO	UNIVERSIDAD DE CASTILLA-LA MANCHA, SPAIN	Parallel Session 1, Conference Room 7 (Level 3)
ORTIZ VALVERDE, GABRIELA	UNIVERSIDAD COMPLUTENSE DE MADRID, COSTA RICA	Parallel Session 5, Conference Room 3 (Level 3)
OSEI-OWUSU, ALBERT	AARHUS UNIVERSITY, DENMARK	Parallel Session 6, Conference Room 4 (Level 3)
OSTOLAZA-BERMAN, RODOLFO	EL COLEGIO DE MÉXICO, MEXICO	
OTCHIA, CHRISTIAN	NAGOYA UNIVERSITY, JAPAN	Parallel Session 3 - Development Programme, Conference Room 3 (Level 3)
OWEN, ANNE	UNIVERSITY OF LEEDS, UNITED KINGDOM	Parallel Session 6, Level 9 - Executive Room B
P, BHANUMATI	MINISTRY OF STATISTICS & PI, INDIA	
PAL, BARUN	INSTITUTE FOR SOCIAL AND ECONOMIC CHANGE, INDIA	
PAN, CHEN	NANJING UNIVERSITY OF AERONAUTICS AND ASTRONAUTICS, CHINA	Parallel Session 7, Conference Room 4 (Level 3) Parallel Session 9, Level 9 - Executive Room B
PAPATHANASOPOULOU, ELENI	PLYMOUTH MARINE LABORATORY, UNITED KINGDOM	
PAULIUK, STEFAN	UNIVERSITY OF FREIBURG, GERMANY	
PEI, JIANSUO	UNIVERSITY OF INTERNATIONAL BUSINESS AND ECONOMICS, CHINA	Parallel Session 6, Conference Room 6 (Level 3)
PENA-BOQUETE, YOLANDA	AYECONOMICS RESEARCH CENTRE, SPAIN	Parallel Session 5, Level 9 - Executive Room B

FULL NAME	INSTITUTION, COUNTRY	CONFERENCE PRESENCE
PEREIRA, EDER	INSTITUTO FEDERAL DO MARANHÃO, BRAZIL	
PEREIRA, HERNANE	CENTRO UNIVERSITÁRIO SENAI CIMATEC, BRAZIL	
PEREIRA, ROBERTO	SEPLAN - SECRETARIA DO PLANEJAMENTO DO ESTADO DA BAHIA, BRAZIL	
PEREZ, MIGUEL	-, SPAIN	
PEROBELLI, FERNANDO	FEDERAL UNIVERSITY OF JUIZ DE FORA, BRAZIL	Parallel Session 6, Conference Room 5 (Level 3)
PHILIPPIDIS, GEORGE	CITA, ARAGÓN, SPAIN	
PINERO, PABLO	UNIVERSITY OF OULU, SPAIN	Parallel Session 1, Conference Room 7 (Level 3)
PLICH, MARIUSZ	UNIVERSITY OF LODZ, POLAND	Parallel Session 9, Level 1 Auditorium
POLBIN, ANDREY	THE RUSSIAN PRESIDENTIAL ACADEMY OF NATIONAL ECONOMY AND PUBLIC ADMINISTRATION, RUSSIAN	Parallel Session 5, Conference Room 8 (Level 3)
POLLITT, HECTOR	CAMBRIDGE ECONOMETRICS, UNITED KINGDOM	Parallel Session 4, Conference Room 7 (Level 3) Parallel Session 6, Conference Room 1 (Level 3)
POLZIKOV, DMITRY	INSTITUTE OF ECONOMIC FORECASTING OF THE RUSSIAN ACADEMY OF SCIENCES, RUSSIAN	Parallel Session 2, Auditorium A
PORTELLA-CARBO, FERRAN	SARCHI INDUSTRIAL DEVELOPMENT, UNIVERSITY OF JOHANNESBURG,, SOUTH AFRICA	
POTASHNIKOV, VLADIMIR	THE RUSSIAN PRESIDENTIAL ACADEMY OF NATIONAL ECONOMY AND PUBLIC ADMINISTRATION, RUSSIAN	
PRETAROLI, ROSITA	UNIVERSITY OF MACERATA, ITALY	
PRZYBYLIŃSKI, MICHAŁ	INSTITUTE OF ECONOMETRICS, UNIVERSITY OF ŁÓDŹ, POLAND	Parallel Session 2, Conference Room 5 (Level 3)
PUCHET ANYUL, MARTÍN	UNAM, MEXICO	
PUTRANTI, TITI	FACULTY OF ADMINISTRATIVE SCIENCES, INDONESIA	
QU, YANG	UNIVERSITY OF EXETER, UNITED KINGDOM	Parallel Session 7, Conference Room 5 (Level 3)
RAES, WILLEM	PUBLIC WASTE AGENCY OF FLANDERS (OVAM), BELGIUM, BELGIUM	Parallel Session 5, Conference Room 4 (Level 3)
RAJAGOPAL, ADVAIT	NEW SCHOOL FOR SOCIAL RESEARCH, INDIA	
RAMOS, PEDRO	GEMF - UNIVERSTY OF COIMBRA, FACULTY OF ECONOMICS, PORTUGAL	
REMOND-TIEDREZ, ISABELLE	EUROSTAT - EUROPEAN COMMISSION, LUXEMBOURG	Parallel Session 5, Level 1 Auditorium
REYNOLDS, CHRISTIAN	THE UNIVERSITY OF SOUTH AUSTRALIA, AUSTRALIA	
RIBEIRO, CAROLINA	UNIVERSIDADE FEDERAL DA BAHIA - UFBA, BRAZIL	Parallel Session 4, Level 9 - Executive Room A
RIBEIRO, LUIZ CARLOS DE	FEDERAL UNIVERSITY OF SERGIPE, BRAZIL	Parallel Session 9, Conference Room 3 (Level 3)
ROCCO, MATTEO	POLITECNICO DI MILANO, ITALY	Parallel Session 9, Conference Room 3 (Level 3)
ROKICKI, BARTLOMIEJ	UNIVERSITY OF WARSAW, POLAND	
ROMÁN, MARIA	EC JRC, SPAIN	
ROSE, ADAM	USC, UNITED STATES	Parallel Session 2, Conference Room 4 (Level 3)
ROSS, ANDREW	FRASER OF ALLANDER INSTITUTE, UNITED KINGDOM	
ROY, GRAEME	UNIVERSITY OF STRATHCLYDE, UNITED KINGDOM	
RUEDA-CANTUCHE, JOSÉ	EUROPEAN COMMISSION, SPAIN	Parallel Session 5, Level 1 Auditorium Parallel Session 8, Level 9 - Executive Room A
RUIZ, ITXASO	BC3 BASQUE CENTRE FOR CLIMATE CHANGE, SPAIN	
RUIZ NAPOLES, PABLO	UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO, MEXICO	Parallel Session 5, Conference Room 1 (Level 3)
SAARI, M. YUSOF	UNIVERSITI PUTRA MALAYSIA, MALAYSIA	Parallel Session 1, Level 1 Auditorium
SAMAVATY, AIDA	ALZAHRA UNIVERSITY, IRAN	
SÁNCHEZ CHÓLIZ, JULIO	UNIVERSITY OF ZARAGOZA, SPAIN	
SANCHO, FERRAN	UNIVERSITAT AUTÒNOMA DE BARCELONA, SPAIN	

FULL NAME	INSTITUTION, COUNTRY	CONFERENCE PRESENCE
SANJUÁN LÓPEZ, ANA	CITA - GOVERNMENT OF ARAGON, SPAIN	
SANZ, MARIA	BASQUE CENTRE FOR CLIMATE CHANGE, SPAIN	
SARABIA, MARIANELA	PHD STUDENT AT THE ARGENTINE UNIVERSITY OF ENTERPRISE (SPANISH ACRONYM: UADE), ARGENTINA	Parallel Session 2, Level 9 - Executive Room A
SARASA, CRISTINA	UNIVERSITY OF ZARAGOZA, SPAIN	Parallel Session 4, Level 9 - Executive Room B
SAVONA, MARIA	UNIVERSITY OF SUSSEX, UNITED KINGDOM	
SCHMIDT, SARAH	NTNU, NORWAY	Parallel Session 8, Conference Room 2 (Level 3)
SELIVANOVA, MARIA	RUSSIAN FOREIGN TRADE ACADEMY MINISTRY OF ECONOMIC DEVELOPMENT OF THE RUSSIAN FEDERATION, RUSSIAN	
SERRANO, ANA	UNIVERSIDAD DE ZARAGOZA, SPAIN	Parallel Session 5, Conference Room 2 (Level 3)
SERRANO, MÒNICA	UNIVERSITY OF BARCELONA, SPAIN	Parallel Session 5, Level 9 - Executive Room B
SETIAWAN, HADI	FISCAL POLICY AGENCY, INDONESIA	Parallel Session 8, Conference Room 5 (Level 3)
SEVERINI, FRANCESCA	UNIVERSITY OF MACERATA, ITALY	Parallel Session 4, Level 9 - Executive Room B
SEVINC, DENIZ	UNIVERSITY OF BIRMINGHAM, UNITED KINGDOM	
SHEN, XUEMEI	CHUBU REGION INSTITUTE FOR SOCIAL AND ECONOMIC RESEARCH, JAPAN	Parallel Session 4, Conference Room 4 (Level 3)
SHI, MINJUN	ZHEJIANG UNIVERSITY, CHINA	
SHI, YIYING	ACADEMY OF MATHEMATICS AND SYSTEMS SCIENCE,CAS, CHINA	
SHIGETOMI, YOSUKE	GRADUATE SCHOOL OF FISHERIES AND ENVIRONMENTAL SCIENCES, NAGASAKI UNIVERSITY, JAPAN	Parallel Session 8, Conference Room 8 (Level 3)
SHIRONITTA, KAYOKO	KYUSHU UNIVERSITY, JAPAN	
SHIROV, ALEXANDER	INSTITUTE OF ECONOMIC FORECASTING RAS, RUSSIAN	Parallel Session 9, Level 9 - Executive Room B
SIMAS, MOANA	NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY, NORWAY	
SINGH, SHWETA	PURDUE UNIVERSITY, UNITED STATES	
SOCCI, CLAUDIO	UNIVERSITY OF MACERATA, ITALY	
SÖDERSTEN, CARL-JOHAN	NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY (NTNU), NORWAY	Parallel Session 7, Conference Room 7 (Level 3)
SONG, XUGUANG	SCHOOL OF STATISTICS, BEIJING NORMAL UNIVERSITY, CHINA	
SOUZA, ALEXANDRE	BRAZILIAN BIOETHANOL SCIENCE AND TECHNOLOGY LABORATORY (CTBE)/ BRAZILIAN CENTER FOR RESEARCH IN ENERGY AND MATERIALS (CNPEM), BRAZIL	Parallel Session 4, Level 9 - Executive Room A
SQUIBB, JAMES	IMPLAN GROUP, LLC, UNITED STATES	Parallel Session 4, Conference Room 1 (Level 3)
STEHRER, ROBERT	THE VIENNA INSTITUTE FOR INTERNATIONAL ECONOMIC STUDIES - WIIW, AUSTRIA	
STEINBERG, JOSEPH	UNIVERSITY OF TORONTO, CANADA	Parallel Session 4, Conference Room 3 (Level 3)
STRACOVÁ, ERIKA	UNIVERSITY OF ECONOMICS IN BRATISLAVA, SLOVAK REPUBLIC	Parallel Session 3 - Development Programme, Level 9 - Executive Room B
STREICHER, GERHARD	WIFO - AUSTRIAN INSTITUT OF ECONOMIC RESEARCH, AUSTRIA	Parallel Session 6, Auditorium A
STRIZHKOVA, LIUBOV	INSTITUTE OF MACROECONOMIC RESEARCHES OF RUSSIAN FOREIGN TRADE ACADEMY, RUSSIAN	Parallel Session 1, Conference Room 5 (Level 3)
SUH, SANGWON	UNIVERSITY OF CALIFORNIA, SANTA BARBARA, UNITED STATES	Parallel Session 1, Conference Room 1 (Level 3)
ŠVARDOVÁ, VIKTÓRIA	UNIVERSITY OF ECONOMICS IN BRATISLAVA, SLOVAK REPUBLIC	Parallel Session 7, Level 1 Auditorium

FULL NAME	INSTITUTION, COUNTRY	CONFERENCE PRESENCE
SWALES, KIM	UNIVERSITY OF STRATHCLYDE, UNITED KINGDOM	Parallel Session 6, Level 9 - Executive Room B Parallel Session 6, Level 9 - Executive Room B
TAKAYABU, HIROTAKA	KYUSHU UNIVERSITY, JAPAN	Parallel Session 9, Conference Room 2 (Level 3)
TANDON, ANJALI	INSTITUTE FOR STUDIES IN INDUSTRIAL DEVELOPMENT (ISID), INDIA	Parallel Session 8, Conference Room 7 (Level 3)
TERAN-VARGAS, JOSE	INEGI, MEXICO	Parallel Session 4, Conference Room 1 (Level 3)
THIERFELDER, KAREN	U.S. NAVAL ACADEMY, UNITED STATES	Parallel Session 1, Level 1 Auditorium
THOMAS, DOUGLAS	NIST, UNITED STATES	Parallel Session 1, Conference Room 1 (Level 3)
THOMASSIN, PAUL	MCGILL UNIVERSITY, CANADA	
TIAN, KAILAN	ACADEMY OF MATHEMATICS AND SYSTEMS SCIENCE, CHINESE ACADEMY OF SCIENCES, CHINA	Parallel Session 9, Conference Room 1 (Level 3)
TISHINA, LIUDMILA	INSTITUTE OF MACROECONOMIC RESEARCHES OF RUSSIAN FOREIGN TRADE ACADEMY, RUSSIAN	
TOBARRA-GOMEZ, MARIA A.	UNIVERSIDAD DE CASTILLA - LA MANCHA, SPAIN	Parallel Session 6, Auditorium A
TÖBBEN, JOHANNES	NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY, NORWAY	Parallel Session 3 - Development Programme, Level 1 Auditorium
TOHMO, TIMO	UNIVERSITY OF JYVÄSKYLÄ, FINLAND	
TOHNO, SUSUMU	KYOTO UNIVERSITY, JAPAN	
TOKITO, SHOHEI	KYUSHU UNIVERSITY, JAPAN	Parallel Session 8, Conference Room 3 (Level 3)
TONINI, FRANCESCO	POLITECNICO DI MILANO, ITALY	Parallel Session 3 - Development Programme, Conference Room 3 (Level 3)
TORO, FRANCISCA	UNIVERSITY OF BARCELONA, SPAIN	
TORRES, LUIS DANIEL	UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO, MEXICO	Parallel Session 2, Level 9 - Executive Room A
TOUZA, LARA	REAL INSTITUTO ELCANO, SPAIN	
TRIGG, ANDREW	THE OPEN UNIVERSITY, UNITED KINGDOM	Parallel Session 9, Conference Room 8 (Level 3)
TRINH, BUI	VIETNAM NATIONAL ACCOUNTS DEPARTMENT, VIETNAM	
TURNER, KAREN	UNIVERSITY OF STRATHCLYDE, UNITED KINGDOM	
UCHIDA, IZUMI	KYUSHU UNIVERSITY, JAPAN	Parallel Session 7, Conference Room 6 (Level 3)
USUBIAGA, ARKAITZ	UCL INSTITUTE FOR SUSTAINABLE RESOURCES, UNITED KINGDOM	Parallel Session 4, Conference Room 7 (Level 3)
UTIT, CHAKRIN	UNIVERSITI PUTRA MALAYSIA, MALAYSIA	Parallel Session 2, Conference Room 1 (Level 3)
VALDERAS JARAMILLO, JUAN MANUEL	UNIVERSIDAD DE SEVILLA, SPAIN	Parallel Session 2, Conference Room 7 (Level 3) Parallel Session 5, Level 1 Auditorium
VALDES IBARRA, MIRIAM	UNIVERSIDAD AUTONOMA DE COAHUILA, MEXICO	
VALE, VINICIUS	FEDERAL UNIVERSITY OF PARANA, BRAZIL	Parallel Session 5, Auditorium A
VAN DEN CRUYCE, BART	FEDERAAL PLANNING BUREAU, BELGIUM	Parallel Session 1, Level 9 - Executive Room B
VAN DER MENSBRUGGHE, DOMINIQUE	PURDUE UNIVERSITY, UNITED STATES	
VAN VUUREN, DETLEF	PBL NETHERLANDS ENVIRONMENTAL ASSESSMENT AGENCY, NETHERLANDS	
VARGA, EVA	HUNGARIAN CENTRAL STATISTICAL OFFICE, HUNGARY	
VELAZQUEZ-AFONSO, AGUSTIN	JOINT RESEARCH CENTRE. EUROPEAN COMMISION, SPAIN	
VENKATESH, ANURADHA	CENTER FOR STUDY OF SCIENCE, TECHNOLOGY & POLICY, INDIA	Parallel Session 7, Conference Room 1 (Level 3)
VERCALSTEREN, AN	VITO, BELGIUM	Parallel Session 4, Conference Room 8 (Level 3)
VILLAMOR, ESTITXU	UNIVERSITY OF BASQUE COUNTRY, SPAIN	Parallel Session 4, Level 1 Auditorium

FULL NAME	INSTITUTION, COUNTRY	CONFERENCE PRESENCE
VIRTANEN, LAURA	CENTER FOR REGIONAL AND TOURISM RESEARCH, DENMARK	Parallel Session 9, Conference Room 5 (Level 3)
VUNNAVA, VENKATA SAI GARGEYA	PURDUE UNIVERSITY, UNITED STATES	
WAKIYAMA, TAKAKO	UNIVERSITY OF SYDNEY AND IGES, JAPAN	Parallel Session 9, Conference Room 7 (Level 3)
WANG, DAOPING	INSTITUTE OF FINANCE AND ECONOMICS, SHANGHAI UNIVERSITY OF FINANCE AND ECONOMICS, CHINA	
WANG, FEI	UNIVERSITY OF INTERNATIONAL BUSINESS AND ECONOMICS, CHINA	
WANG, JIAYU	CENTER FOR ENERGY & ENVIRONMENT POLICY RESEARCH, BIT, CHINA	Parallel Session 2, Conference Room 4 (Level 3)
WANG, KE	CENTER FOR ENERGY AND ENVIRONMENTAL POLICY RESEARCH & SCHOOL OF MANAGEMENT AND ECONOMICS, BEIJING INSTITUTE OF TECHNOLOGY, CHINA	
WANG, YAFEI	INSTITUTE OF NATIONAL ACCOUNTS, BEIJING NORMAL UNIVERSITY, CHINA	Parallel Session 9, Conference Room 7 (Level 3)
WANG, YAFEI	CHONGQING NORMAL UNIVERSITY, CHINA	
WANG, ZHI	USITC, UNITED STATES	
WATANABE, MARCOS	CTBE/CNPEM, BRAZIL	
WEI, RUI	SCHOOL OF ECONOMICS AND TRADE, HUNAN UNIVERSITY, CHINA	
WEI, WAN	PARTY SCHOOL OF JIANGSU PROVINCIAL PARTY COMMITTEE, CHINA	Parallel Session 3 - Development Programme, Conference Room 2 (Level 3)
WEILER, STEPHAN	COLORADO STATE UNIVERSITY, UNITED STATES	
WIEBE, KIRSTEN	NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY, NORWAY	Parallel Session 5, Conference Room 5 (Level 3)
WIEDMANN, THOMAS	UNSW, AUSTRALIA	
WIELAND, HANSPETER	INSTITUTE FOR ECOLOGICAL ECONOMICS (WU VIENNA), AUSTRIA	
WILTING, HARRY	PBL NETHERLANDS ENVIRONMENTAL ASSESSMENT AGENCY, NETHERLANDS	Parallel Session 6, Conference Room 2 (Level 3)
WIRKIERMAN, ARIEL	GOLDSMITHS, UNIVERSITY OF LONDON, UNITED KINGDOM	Parallel Session 2, Auditorium A
WOLTER, MARC INGO	INSTITUTE FOR ECONOMIC STRUCTURES RESEARCH (GWS), GERMANY	Parallel Session 7, Level 9 - Executive Room B
WOOD, RICHARD	NTNU, NORWAY	Parallel Session 2, Conference Room 7 (Level 3)
WU, RUI	NANJING NORMAL UNIVERSITY, CHINA	Parallel Session 8, Level 1 Auditorium
XIA, YAN	INSTITUTES OF SCIENCE AND DEVELOPMENT, CAS, CHINA	Parallel Session 6, Conference Room 6 (Level 3)
YAGI, TAKASHI	MEIJI UNIVERSITY, SCHOOL OF POLITICAL SCIENCE AND ECONOMICS, JAPAN	Parallel Session 2, Conference Room 5 (Level 3)
YAMANO, NORIHIKO	OECD, FRANCE	Parallel Session 4, Conference Room 7 (Level 3)
YAN, BINGQIAN	CHINESE ACADEMY OF SOCIAL SCIENCES, CHINA	Parallel Session 8, Conference Room 6 (Level 3)
YAN, XIAOYU	UNIVERSITY OF EXETER, UNITED KINGDOM	
YANG, CUIHONG	SOUTH BUILDING, ACADEMY OF MATHEMATICS AND SYSTEMS SCIENCE, CAS, CHINA	Parallel Session 8, Conference Room 4 (Level 3)
YANG, JANGHO	NEW SCHOOL FOR SOCIAL RESEARCH, UNITED STATES	
YE, MING	OECD, FRANCE	Parallel Session 1, Conference Room 8 (Level 3)
YEO, YEONGJUN	SEOUL NATIONAL UNIVERSITY, KOREA, REPUBLIC OF	Parallel Session 6, Conference Room 8 (Level 3)
YONEZAWA, HIDEMICHI	STATISTICS NORWAY, NORWAY	
YUAN, JIANQIN	STATE INFORMATION CENTER(SIC), CHINA	
YUAN, XIAOHUI	RESEARCH CENTRE FOR JIANGSU APPLIED ECONOMICS, JIANGSU ADMINISTRATION INSTITUTE, CHINA	
ZAFRILLA, JORGE	UNIVERSITY OF CASTILLA-LA MANCHA, SPAIN	Parallel Session 1, Conference Room 2 (Level 3)

FULL NAME	INSTITUTION, COUNTRY	CONFERENCE PRESENCE
ZELIN, JIANG	INSTITUTE FOR THE DEVELOPMENT OF CENTRAL CHINA,WUHAN UNIVERSITY, CHINA	Parallel Session 2, Conference Room 2 (Level 3)
ZENZ, DAVID	VIENNA INSTITUTE FOR INTERNATIONAL ECONOMIC STUDIES, AUSTRIA	
ZHANG, HONG	TSINGHUA UNIVERSITY, CHINA	Parallel Session 5, Conference Room 1 (Level 3)
ZHANG, HONGXIA	SCHOOL OF ECONOMICS, RENMIN UNIVERSITY OF CHINA, CHINA	Parallel Session 9, Level 1 Auditorium
ZHANG, JUNRONG	ACADEMY OF MATHEMATICS AND SYSTEMS SCIENCE, CHINESE ACADEMY OF SCIENCES, CHINA	Parallel Session 1, Conference Room 2 (Level 3)
ZHANG, XUEMEI	UNIVERSITY OF CHINESE ACADEMY OF SCIENCES, CHINA	
ZHANG, YAXIONG	INTERNATIONAL COOPERATION CENTRE OF NDRC, CHINA, CHINA	Parallel Session 7, Conference Room 4 (Level 3) Parallel Session 8, Conference Room 4 (Level 3)
ZHANG, ZENGKAI	TIANJIN UNIVERSITY, CHINA	Parallel Session 3 - Development Programme, Auditorium A
ZHANG, ZHONGHUA	TSINGHUA UNIVERSITY, CHINA	Parallel Session 4, Level 1 Auditorium
ZHANG, ZHUOYING	ACADEMY OF MATHEMATICS AND SYSTEMS SCIENCE, CHINESE ACADEMY OF SCIENCES, CHINA	Parallel Session 9, Conference Room 7 (Level 3)
ZHAO, HAOYANG	UNIVERSITY OF CHINESE ACADEMY OF SCIENCE, CHINA	
ZHENG, HERAN	UNIVERSITY OF EAST ANGLIA, UNITED KINGDOM	Parallel Session 3 - Development Programme, Auditorium A Parallel Session 5, Conference Room 5 (Level 3)
ZHONG, SHENG	ENERGY STUDIES INSTITUTE, NATIONAL UNIVERSITY OF SINGAPORE, SINGAPORE	Parallel Session 1, Conference Room 3 (Level 3)
ZHOU, DEQUN	NANJING UNIVERSITY OF AERONAUTICS AND ASTRONAUTICS, CHINA	
ZHU, KUNFU	RESEARCH CENTER OF GLOBAL VALUE CHAINS, UIBE, CHINA	
ZHU, LINGXIU	ACADEMY OF MATHEMATICS AND SYSTEMS SCIENCE,CAS; UNIVERSITY OF CHINESE ACADEMY OF SCIENCES, CHINA	Parallel Session 2, Conference Room 2 (Level 3)
ZHU, XUEQIN	WAGENINGEN UNIVERSITY, NETHERLANDS	
ZIKA, GERD	INSTITUTE FOR EMPLOYMENT RESEARCH, GERMANY	
ZOTTI, JACOPO	UNIVERSITY OF TRIESTE - DEPARTMENT OF POLITICAL AND SOCIAL SCIENCES, ITALY	
ZUOYI, YE	SHANGHAI UNIVERSITY OF INTERNATIONAL BUSINESS AND ECONOMIC, CHINA	Parallel Session 2, Conference Room 6 (Level 3)