# 24th IIOA Conference in SEOUL, Korea

*BOOK OF ABSTRACTS*
*AND LIST OF AUTHORS*

03/Jul/2016 - 08/Jul/2016

**International Input-Output Association**
Vienna, AUSTRIA
**www.iioa.org**

Scientific Program Committee

Chair

Satoshi Inomata (Institute of Developing Economies, JETRO, Japan)

Members (in the alphabetical order)

Albert E. Steenge (University of Groningen, the Netherlands)
Anushree Sinha (National Council of Applied Economic Research, India)
Bart Los (University of Groningen, the Netherlands)
Bo Meng (Institute of Developing Economies, JETRO, Japan)
Cuihong Yang (Chinese Academy of Sciences, PRC)
Davin Chor (National University of Singapore, Singapore)
Doug Meade (INFORUM/University of Maryland, USA)
Euijune Kim (Seoul National University, Republic of Korea)
Glen Peters (Center for International Climate and Environmental Research - Oslo, Norway)
Hubert Escaith (World Trade Organisation)
Isabelle Remond-Tiedrez (European Commission, Eurostat)
Jae-Un Park (Busan Economic Promotion Agency, Republic of Korea)
Jiemin Guo (U.S. Bureau of Economic Analysis, USA)
Joaquim Guilhoto (Department of Economics, University of São Paulo, Brazil)
Jong-Hwan Ko (Pukyong National University, Republic of Korea)
Jose Manuel Rueda-Cantuche (European Commission, Joint Research Centre)
Kakali Mukhopadhyay (McGill University, Canada)
Kazuhiko Nishimura (Nihon Fukushi University, Japan)
Kazusuke Tsujimura (Keio University, Japan)
Kazuyo Matsubae (Tohoku University, Japan)
Keisuke Nansai (National Institute for Environmental Studies, Japan)
Kiho Jeong (Kyungpook National University, Republic of Korea)
Kiyoshi Fujikawa (Nagoya University, Japan)
Kunfu Zhu (University of International Business and Economics)
Kurt Kratena (Centre of Scenario Analysis and Research, Spain)
Makiko Tsukui (Tokyo International University, Japan)
Manfred Lenzen (University of Sydney, Australia)
Nadim Ahmad (Organisation for Economic Co-operation and Development)
Norihiko Yamano (Organisation for Economic Co-operation and Development)
Pablo Ruiz-Napoles (Universidad Nacional Autonoma de Mexico, Mexico)
Peter Rørmose Jensen (Statistics Denmark, Denmark)
Robert Stehrer (Vienna Institute for International Economic Studies, Austria)
Roberto Roson (Ca'Foscari University - Venice, Italy)
Rosa Duarte (University of Zaragoza, Spain)
Rutger Hoekstra (Statistics Netherlands, the Netherlands)
Sangwon Suh (University of California, Santa Barbara, USA)
Satoshi Nakano (Japan Institute for Labour Policy and Training, Japan)
Shigemi Kagawa (Kyushu University, Japan)
Thomas Wiedmann (UNSW, Australia)
Yasuhide Okuyama (University of Kitakyushu, Japan)
Yasushi Kondo (Waseda University, Japan)
Yaxiong Zhang (State Information Center, PRC)

# Table of Contents

## Updating the WIOD database in the virtual laboratory environment

Topic: 714W  Special session: Input-Output Virtual Laboratories (1)
Author: Muhammad Daaniyall ABD RAHMAN
Co-Authors: Bart LOS, Arne GESCHKE, Yanyan XIAO, Keiichiro Kanemoto, Manfred LENZEN

The World Input-Output Database (WIOD) has been widely utilised in many research applications. These popular uptakes are driven by the facts that WIOD provides with extended international trade market integration and time series covering year 1995-2011. With the view to continuity for the existing WIOD user community, we describe the processes of updating the WIOD in a virtual laboratory environment called the Global MRIO Lab (Global IELab). The Global IELab system has been designed to replicate closely the original WIOD construction pipelines. The only major departure from WIOD practice is that we apply a single-step reconciliation procedure compared to WIODs original two-step reconciliation process. The single-step reconciliation procedure considers both SUT and trade data sources, whereas the original two-step procedure handles these types of data sources separately. Compiling the WIOD database in the Global IELab offers a number of advantages such as flexibility in terms of sectoral and spatial resolution, a less labour-intensive and hence more cost-effective data integration process, and a faster turnaround time for data updates. These advantages are largely owed to the high degree of automation within the Global IELab. Therefore, implementation of the WIOD database in the Global IELab will allow for timely and continuous updates in the future.

## Mapping global value chains of low carbon technologies diffusion from OECD to ASEAN countries using input-output analysis

Topic: 716F  Technology and Environment
Author: Ambiyah ABDULLAH

In recent years, global value chains and low carbon technologies have been discussed intensively in international discussion on trade and climate change. Globalization had strengthened the internationally fragmented of global production, trade and investment among countries. Simultaneously, the 2015 COP21 Paris Agreement and the 9th goal of the 2030 SDGs mention the important roles of low carbon technologies innovation and diffusion from developed countries to support the low carbon economy of developing countries. Japan, US, UK, Germany and France are among OECD countries who are actively promoting the low carbon technologies diffusion to developing countries through several channels (e.g. trade, FDI, ODA). In recent years, ASEAN countries provide the promising market demands for low carbon technologies diffusion from OECD countries. The high economic growth, emissions reduction targets, energy sector reforms, and ASEAN Economic Community (AEC) are four major factors that attract OECD countries to shift their low carbon technologies diffusion to ASEAN countries.
Against this background, this study aims to map the positions of selected OECD (Japan, US, UK, Germany, and France) and ASEAN countries in global value chains of low carbon technologies. This study tries to answer three research questions as follows. First, what are the value-added shares of low carbon technologies diffusion from selected OECD countries to ASEAN countries during the period 2005 to 2014? Second, how many production stages of global value chains of low carbon technologies in selected OECD countries during period 2005 to 2014? Third, what are positions and comparative advantages of each selected OECD and ASEAN countries in global value chains of low carbon technologies during the period 2005 to 2014?
Several recent studies in global value chains have utilized input-output analysis using OECD/IO table, IDE JETRO/AIIOTs, GTAP database, and WIOD (e.g. Yamano et al. (2010); Backer et al.

(2012); Inomata (2012); Meng et al. (2012); Timmer (2012); Backer et al. (2013); Koopman et al. (2014); Timmer et al. (2014) and Los et al. (2015)). This study applies the similar methods used in the previous studies (trade in value added indicators) using the time series of OECD-IO tables (released on June 2, 2015) which cover years of 2005, 2008, 2009, 2010 and 2011. This study focuses on selected 23 low carbon technologies for the cases of selected OECD countries (Japan, US, UK, Germany, France, and Korea) and ASEAN countries.
Since the most-disaggregated available OECD IO table covers only 34 industries classifications based on ISIC Rev.3, this study single-outs the selected 23 low carbon technologies from its parent sectors using the calculated disaggregation ratios. To do so, this study firstly collect the bilateral trade data of selected 23 low carbon technologies from selected OECD and ASEAN countries using UNCOMTRADE Data from year 2005 to 2014. Secondly, as UNCOMTRADE data uses HS codes, this study corresponds the UN COMTRADE data of low carbon technologies with bilateral trade matrix of selected low carbon technologies with the OECD-IO table which uses ISIC classification. Thirdly, this study calculates the disaggregation ratios of each selected 23 low carbon technologies to disaggregate it from each parent sectors. Fourthly, this study applies the value added-in trade methods to conduct global value chains analysis of selected low carbon technologies. The input-output analysis in this study measures the various indexes represent the participation, length, distances, and comparative advantages of each selected OECD countries in global value chain of low carbon technologies diffusion to ASEAN Countries. The results of this study can assist policy makers in selected OECD countries to draw better supporting policies (trade and investment) in gaining better benefits of global value chains as well as to seek possible further co-operations among selected OECD countries for low carbon technologies diffusion to ASEAN countries.
The originalities of this study are two folds. First, this study combines two recent issues (GVCs-IO analysis) and low carbon technologies into one possible IO model by disaggregating the selected 23 low carbon technologies from the OECD-IO table. Second, this study tries to map and measure the position and comparative advantages of each selected OECD countries in global value chain of low carbon technologies diffusion to ASEAN countries.
Keywords: low carbon technologies diffusion, OECD, ASEAN, comparative advantage, global value chains-IO analysis

## Measuring the economic relevance of sports - the sport satellite account (SSA) approach

Topic: 714Z  IO Accounts and Statistics (2)
Author: Gerd AHLERT
Co-Authors: Iris an der Heiden

(1) For many people sport is their favourite leisure activity. Whether for active participation as a leisure sportsperson or passively following as a spectator of sporting events, the enthusiasm for sport leads to a wide range of expenses such as the purchase of sports equipment and clothing, or the entry charges to visit sports facilities or events. Although sport has a high relevance at the individual and societal level, the measuring of its macro-economic relevance is a rather young discipline.
(2) Because of its high degree of social importance, the EU Commission introduced in 2007 a “White Paper on Sport” which recommends an adequate and consistent measurement with the National Accounts (see COM 2007). Although a couple of years ago some EU Member States (i.a. Austria, Netherlands, Poland, United Kingdom, Germany) have compiled first national “pilot” SSA a more regular SSA based monitoring has been only implemented for a few countries (Ahlert 2013, EC 2013). At present, the calculations are only regularly carried in three countries (Ahlert &

An der Heiden 2015, Department of Culture, Media an Sports 2015, Statistics Netherlands et al. 2015).
(3) Against this background, the basic methodology of the SSA approach - using the Input-Output database as a starting-point - will be explained. In this context, especially the availability and inclusion of sport specific economic information will be discussed in more detail.
(4) The latter also suggests the how to possible implementation hurdles for a first time but also its regular calculation. The paper will give some practical recommendations how to “handle” them. Finally, the paper will show how the SSA results can be used in economic analysis and societal debate.

Bibliography:
Ahlert, G. (2013): The German Sport Satellite Accounts (SSA). GWS Discussion Paper 13/4, Osnabrück.
Ahlert, G. & An der Heiden, I. (2015): Die ökonomische Bedeutung des Sports in Deutschland - Ergebnisse des Sportsatellitenkontos 2010 und erste Schätzungen für 2012. GWS Themenreport 15/1, Osnabrück.
Commission of the European Communities (COM)(2007): White Paper on Sport. COM(2007)391 final, Brussels.
Department of Culture, Media and Sports (2015): 2010 Sport Satellite Account for the UK. Statistical Release, London.
European Commission, DG Education and Culture (EC)(2013): Sport Satellite Accounts – A European Project: New Results, Brussels.
Statistics Netherlands (2015): Sport in focus – The contribution of sport to the Dutch economy in 2006, 2008 and 2010 (Summary). The Hague.

## GINFORS (version 3): A global simulation model on the basis of WIOD and its application

Topic: 809F Environmental IO Modelling (4)
Author: Gerd AHLERT
Co-Authors: Martin Distelkamp, Mark Meyer

(1) The multi-regional input-output simulation model GINFORS permits wide-ranging ex ante as well as ex post simulation studies, particularly on globally relevant topics in areas such as global developments and resource use. In a couple of European research projects (CECILIA2050, ToPDAd, POLFREE, SimRess) the GINFORS (version 3) of the model (see Meyer et al. 2013) and the underlying MRIO database WIOD (see Dietzenbacher et al. 2013) has been applied to analyse the following questions:
- Is the assumption of free combinability of alternative climatic representative concentration pathways (RCP, see Moss et al. 2010) and shared socioeconomic pathways (SSP, see O'Neill et al. 2014) reliable?
- What decarbonizing policy mix could be able to meet the global ‘2 Degrees’ target?
- Which alternative economic indicators for international resource productivity assessment is appropriate?

(2) In GINFORS all countries in the EU27, all OECD countries, the BRIC countries and a Rest of the World region are explicitly modeled. Its empirical modelling framework rests on national Input-Output accounts that are bilaterally interconnected by international trade at the industry level. It depicts the global economic, social and environmental relations for each country in deep product group detail (59), including the inputs of capital (fixed and intermediate), labour markets and the developments of all components of final demand depending on relative prices. The prices

of all products are explained by the unit costs of the 35 sectors. The macro variables are given by explicit aggregation of the sectoral variables determining GDP as the aggregate of sectoral value added. The energy intensities for heating, mobility and electricity for the use of machinery and household appliances are explained by relative prices for each of the 35 sectors and private households in each of the 39 countries. The carrier structure also depends on their price relations. All parameters of the model are estimated econometrically.
Assuming bounded rationality of agents and imperfect markets, an iterative solution algorithm facilitates ex ante simulation studies of the non-equilibrium features of globalizing economies. From a methodological point of view, GINFORS might thus be categorised as a completely integrated dynamic simulation model. The effects of national policy measures and environmental policy measures can be extensively analysed assuming alternative global conditions; indirect international spill-over effects are modelled automatically.
(3) The GINFORS approach relies heavily on the availability of harmonised international Input-Output datasets (preferably as annual time series). The actual model version (labeled GINFORS 3) therefore represents our first GINFORS release, which has been built upon a fully harmonized annual set of national Supply and Use Tables (SUT), i.e., the outcomes of the WIOD project. Population of the different countries is exogenous and was taken from the UN medium variant forecast. The extraction prices of fossil fuels were obtained from the IEA 2012 Energy Technology Perspectives.
(4) The application of GINFORS version 3 indicates that
- (at least some of) the combinations of climatic and socioeconomic pathways prepared for the Intergovernmental Panel for Climate Change (IPCC) contain inconsistencies between the socioeconomic assumptions and the emissions in the pathway combinations,
- a holistic decarbonizing strategy - a carbon price combined with the decarbonisation of process heat especially in the power sector, electrification of land transport and improvements in the energy efficiency of buildings - is (nearly) able to meet the global 2 degrees target and the European 80% reduction target,
- the RMI (Raw Material Input)-based productivity indicator shows advantages over the commonly reported GDP/DMC (Domestic Material Consumption) or GDP/RMC (Raw Material Consumption) indicators.

Bibliographie:
Dietzenbacher, E., B. Los, R. Stehrer, M. Timmer & G. de Vries (2013). The construction of World Input-Output Tables in the WIOD Project. Economic Systems Research 25(1), 71–98.
Meyer, B., Ahlert, G., Distelkamp, M. & M. Meyer (2013). Macroeconomic Modelling of the Global Economy-Energy-Environment Nexus - an Overview of Recent Advancements of the Dynamic Simulation Model GINFORS. GWS Discussion Paper 13/5, Osnabrück.
Meyer, B., Distelkamp, M. & T. Beringer (2014). Report about integrated scenario interpretation GINFORS/LPJmL results. POLFREE Deliverable 3.7, Osnabrück.
Meyer, B., Ahlert, G. & M. Meyer (2014): Assessment of environmental impacts under alternative adaptation measures. ToPDAd Deliverable 3.3, Helsinki.
Meyer, B., Meyer, M. & M. Distelkamp (2014): Macroeconomic routes to 2050 – choosing efficient combinations of policy instruments for low-carbon development and innovations to achieve Europe´s 2050 climate targets. CECILIA2050 Deliverable 3.2, Osnabrück.

## Fiscal policy for low income households and public budget constraint in Italy

Topic: 811C  CGE/econometric IO Modelling (2)
Author: Irfan AHMED

The recent prolonged global financial and economic recession has significantly affected the Euro Area economies.  The continuing fragility of Euro area economies has reduced the propensity of businesses and households to invest and to consume. The scarce sources of income have reduced the spending capacity which ultimately reduces the final demand in the Euro Area. Against this backdrop, the government of Italy has contemplated a potential recovery and has introduced a stability law for 2015-2017 which aims at reducing the public expenditures and promoting the investments and to revising the personal income tax bonus for low and medium income brackets for 2015. The government decided to pay 80 Euro per month to the low income households in order to boost the productivity of the economy.

This study aims to investigate the impact of tax-cut policy on the disposable incomes of the institutional sectors, value added by commodities and GDP of the country. The study constructs Social Accounting Matrix (SAM) for Italy with the disaggregation of low level, medium level and high level income households. A neo-classical computable general equilibrium (CGE) model is employed. Two policy scenarios are simulated. The first simulation includes the transfers of 6 billion Euros to the low income households and this tax-cut is compensated by the tax transfers from other institutional sectors. Findings confirm increase in the disposable income of low income households. On the other hand the GDP has a decline of 0.04 percent. The value added by commodities undergoes mixed results wherein some commodities have increased value added while the value added by few commodities evidence a decline. The second simulation evidences increase in GDP by 0.03 percent. The disposable income of all institutional sectors, except high income households, has been increased. The value added undergoes the changes similar to the changes in first simulation.

## Cost-push Inflation in Turkey: An Input-Output Analysis

Topic: 516A  Financial Analysis
Author: K. Ali AKKEMIK

Turkish economy was plagued by high inflation rates from the early 1970s to the mid-2000s. High inflation in Turkey was generally attributed to macroeconomic factors such as public deficit and monetary policies and demand-pull factors. Cost-push inflation is also important and it is ignored in the analysis of inflation in Turkey. This paper examines cost-push inflation in Turkey from 1973 to 2002 and its sources using national input-output tables, which are converted into constant-price input-output tables, and a decomposition analysis. Sectoral contributions of cost-push inflation are also examined. The findings are interpreted in conjunction with the development trajectory of the country.

## Evaluation of the reform in Turkish electricity sector: A CGE Analysis

Topic: 716Y  Energy IO Modelling (3)
Author: K. Ali AKKEMIK
Co-Authors: Erisa Dautaj Senerdem

Turkey’s electricity market has undergone extensive reform since 2001 through market liberalization, unbundling, privatization, and establishment of organized power markets, retail market opening, and the establishment of an independent energy regulatory authority. We employ a static computable general equilibrium (CGE) model to test the impact of power sector reform on the economy. We construct Turkey’s social accounting matrix (SAM) for 2010 by using technological coefficients from 2002 input-output tables – the most recent published by Turkey’s statistics agency, but opt for actual values for energy accounts in SAM using data published by the International Energy Agency and Turkey’s energy regulator. Major findings suggest reform has for a major part been beneficial to the economy. We find out that gross domestic product (GDP) deviates by 0.35% from the baseline when monopolistic rent is reduced in all state-run power companies simultaneously. For the first time, the impact of the establishment of a day-ahead power market (DAM) and privatization of state-run electricity utilities on the economy is tested, with findings suggesting both reform elements affect the economy positively. Larger participation of state-run electricity companies in the DAM generates a positive effect similar to that of privatization, with the GDP turning around 0.2-0.3% above its baseline level after each shock.

## Carbon, Water and Land use accounting: Consumption vs Production perspectives

Topic: 714F  Environmental IO Modelling (3)
Author: Yousaf ALI

The traditional approach of accounting of environmental pressure in the Kyoto Protocols follows the production-based accounting, which attributes all environmental pressures generated from production activities within a country boundary to that country total environmental pressure. However, the major flaws of this approach is that it does not take into account environmental pressures embodied in imports and so build stimulus for shifting of environmental pressures abroad. An alternative approach to include environmental pressures associated with imports to the country and subtract export related environmental pressures is the consumption-based approach or footprint approach. This approach has been widely considered as an alternative way to more adequately allot responsibilities between the emitters and final consumers. This study compares and discusses the concepts of both approaches, showing the results of an empirical analysis and going into the application of the two different perspectives in worldwide environmental policies. This paper presents the results of an analysis of the Carbon, water and land footprints of the worldwide from 1995 to 2009, and comparing the outcomes for the two approaches for four world regions (i.e. EU, OECD, BRIC and RoW). The analysis is based on a multi-region input output (MRIO) model to assess these environmental pressures. The proposed model use the world-input-output-database (WIOD) covering 35 sectors and 41 countries. The results shows that during the entire study period, the carbon emissions, land use and water use for the EU and OECD regions are higher in the consumer approach than in the producer approach. The results further indicate that, for the BRIC and rest of the world (RoW) regions, the carbon emission, land and water use are higher in the producer approach than in consumer approach.

# The analytical complementarity of input-driven and output-driven models

Topic: 714B Methodological Aspects of IO Analysis (2)
Author: Aleix ALTIMIRAS-MARTIN

Input-driven (Ghosh) and output-driven (Leontief) models are algebraically equivalent; however, their use has not been interpreted as equivalent and has been subject to reinterpretations. Since its first days, the Leontief model is used to determine the total requirements of the economy (primary inputs) to produce specific final goods. On the other hand, the original Ghosh models have been initially interpreted as the final production response to using certain primary inputs but later reinterpreted as a price model whereby changes in the primary inputs alter the prices in final outputs.

This paper aims to demonstrate that such reinterpretation is misleading by clarifying the "equivalence" between both models, specifically by deriving both models algebraically and then by arguing which questions each model is able to answer. It also aims to show that both models can be simultaneously used to better understand the structure of the economy.

First, in the theoretical part, the concepts of "product-based" and "input-based" structures are introduced to show how the same algebraic structure (i.e. the corresponding Leontief or Ghosh inverse matrices) may be used to answer different questions. In particular, the output-driven model reveals what primary inputs are required to produce a specific final output, and the input-driven uncovers in which final goods each primary input ends up (i.e. the Ghosh model shows into which final goods primary inputs are embedded). It is also shown that the Ghosh model should be interpreted as a quantity model, following its original development.

In the practical part, the previous concepts are applied to a monetary input-output table, to a physical input-output table representing the economy and to a physical input-output table representing an ecosystem. It is shown that, despite being equivalent, both models reveal different structural features, and enable researchers to perform different types of analyses, each answering different types of questions.

The paper concludes that when a system – such as the economy – is driven by its outputs, only output-driven models can "drive" the system into a new state. However, within a given state, input-driven models can be used to provide complementary analyses (e.g. in which proportion are primary inputs allocated to final outputs). The opposite is true for input-driven systems such as ecosystems: only input-driven models can be used to drive the system into a new state and, then, output-driven models can be used for complementary analyses. Thus, this paper crystallises the use of the Ghosh model by clarifying previous work and expanding the analytical options of IOA within economics, industrial ecology and biology, specifically by providing new insights on the allocation of monetary and physical flows between primary inputs and final outputs.

## A quantity output-driven model with heterogeneous intermediate and final outputs

Topic: 716B  Methodological Aspects of IO Analysis (3)
Author: Aleix ALTIMIRAS-MARTIN

The traditional quantity output-driven (Leontief) model is based on the assumption that outputs are homogeneous. This assumption is considered fundamental for the model to operate properly.

Although the actual heterogeneity of goods can partially be overcome by disaggregating input-output tables, such assumption constitutes a limitation of the modelling exercise. Also, in order to comply to this assumption, secondary production must be reallocated to other sectors instead of counting such production within the same sector, for example as a different (heterogeneous) final good. Thus, reallocation methods have been used to build symmetrical input-output tables according to the homogeneous goods assumption.

This paper aims to explore whether the homogeneous goods assumption can be dropped and, if so, to explore how would a quantity output-driven IO model work.

In this paper, the assumptions required by the traditional quantity output-driven (Leontief) model are reviewed together with the previous methods to account for secondary production. It is found that some methods applicable to physical input-output tables are already able to deal with simultaneously produced heterogeneous final outputs (e.g. disposals to nature).

In the analytical section of this paper, the usage of the homogeneous goods assumption is deconstructed. First, by illustrating how to deal with PIOTs and MIOTs with heterogeneous intermediate production. Second, by illustrating how to deal with PIOTs and MIOTs with heterogeneous final production. Building on the learnings from these sections, a generalised quantity output-driven model is suggested. It is demonstrated that the traditional quantity output-driven (Leontief) model is a particular case of the generic quantity output-driven developed in this paper.

The generic quantity output-driven model makes it possible to build and analyse MIOTs and PIOTs without requiring to reallocate secondary production to the corresponding sector, i.e. secondary products can be considered within the intersectoral matrix and/or as final outputs. This enhances the analytical possibilities of IOA and opens the door to rethink how secondary production should be treated. Finally, this model is particularly interesting for Industrial Ecology, since enables researchers to trace the physical activity of the economy as is, i.e. each sector producing simultaneously different types of disposals to nature (e.g. emissions).

## Corporate income tax reform in the EU

Topic: 714X  Special session: Taxation
Author: Maria Teresa ALVAREZ-MARTINEZ
Co-Authors: Maria Gesualdo, Dimitrios Pontikakis, Jonathan Pycroft

Corporate tax reforms in the EU are motivated by evidence that the current system is unfair and inefficient. Uncoordinated national tax regimes can feature tax loopholes and inconsistencies in the treatment of corporate profits across borders that give rise to strategic tax planning by multinational corporations. There is growing recognition of these issues and a renewed impetus

to address them. Attempts to improve international coordination of national corporate tax policies are being undertaken through the OECD Base Erosion and Profit Shifting (BEPS) Project.
In this paper, we evaluate the effects that changing the corporate income tax (CIT) rate may have on EU countries using a Computable General Equilibrium (CGE) model. The model captures the key features of the corporate tax regimes including investment decisions, loss compensation, multinational profit shifting and the debt-equity choice of firms. This is a multi-regional model including all 28 EU member states, the USA and Japan. It encapsulates the behaviour of all economic agents, reflecting both the direct and indirect effects of policy changes on macroeconomic variables, such as GDP, investment and employment.
We simulate the impact of removing differences in corporate tax rates across EU countries and their effect on tax competition considering both uncoordinated and coordinated changes. For each of the three simulations, revenue neutrality is maintained by adjusting labour taxes to compensate for any revenue increase or shortfall caused. In addition, sensitivity analysis is performed, ensuring budget neutrality through adjusting transfer to pensioners or government expenditure. We first consider simulations where one country raises or lowers its rate in isolation. We simulate an upward adjustment in a low CIT tax economy, namely Ireland, up to the level of a higher tax economy, namely Germany. These two countries represent to polar examples since Ireland has the lowest statutory CIT rate in the EU and in Germany, which is the largest country in the Union, the CIT rate is among the highest. Second, we simulate the reverse case, where Germany reduces its rate to the Irish level. In each case, we observe the impact on the country affected as well as the international spillover effects. The third simulation supposes that all EU member states choose to harmonise their CIT rates at the EU average level.
The first two simulations reveal that a tax shift from labour tax to corporate tax (Ireland) has a negative impact on GDP, whilst a tax shift from corporate tax to labour tax (Germany) has a positive impact on GDP. On the other hand, the impact on (after-tax) wages moves in the opposite direction. As anticipated, the German CIT rate simulation causes larger spillover effects, with all other countries' GDP being negatively affected to some degree. Nevertheless, the benefits to Germany are sufficient to slightly raise EU GDP by 0.19 percent.
The third simulation, where CIT rates are harmonised across the EU, tends to suggest that a tax shift from corporate tax to labour tax raises GDP, whilst the opposite tax shift lowers GDP; this holds true for 22 out of 28 EU countries. The aggregate impact is a small fall in EU GDP of 0.13 percent. This result broadly holds for the alternative budget-neutral closures. A benefit of CIT rate harmonisation is that it removes much of the incentive to engage in profit shifting.
We conclude that reforming corporate taxes can generate substantial responses within the implementing country as well as beyond its own borders. Harmonisation of CIT rates would likely involve winners and losers, and as such, may be best pursued gradually and as part of a broader package of corporate tax reform.

## Adult education, labour market outcomes and income distribution in India: An Analysis using a CGE model

Topic: 809D  Special session: Modeling Impacts of Structural Change in Emerging Economies (1)
Author: Ganesh Kumar ANAND
Co-Authors: Runu Bhakta

1. Research question:

The linkages between adult education and the skill level of labour force is well recognized as a crucial factor determining the overall economic performance of a country. Empirical assessment of this linkage and its impact on the economy, however, is far and few especially in the Indian context. This paper attempts to study this issue for India.

2. Method:
The paper uses a recursive computable general equilibrium (CGE) model of the Indian economy to study this issue.

3. Data:
The model is based on a new Social Accounting Matrix (SAM) for the base year 2011-12. The SAM reflects the structure of the economy observed in the base year as per the new series of the National Accounts Statistics (NAS) with base year 2011-12. It may be noted that the new series of the NAS was released recently in January 2015. The SAM combines NAS data with nationally representative household surveys on consumption, employment and unemployment conducted by the National Sampling Survey Organisation (NSSO), Government of India.

4. Novelty in the research:
A key feature of this CGE model is that it endogenizes the linkage between adult education levels and composition of labour supply in terms of unskilled, semi-skilled and skilled labour. To the best of our knowledge, hardly any study exists, at least in the Indian context, that brings forth this linkage.

5. Key results:
Projections over the period 2015-16 to 2030-31 for a Business As Usual scenario show that progress in adult education – as measured by the average years of schooling and the percentage of adult population that has completed higher education – has a significant impact on the size of unskilled, semi-skilled and skilled labour force. Semi-skilled and skilled labour force expands while unskilled labour force declines in absolute numbers. These changes in the composition of the labour force affect labour market outcomes, with unskilled wage rates rising sharply relative to the wages of semi-skilled and skilled labour. The change in the relative wage rates in turn have a favourable impact on the overall income distribution across households through a reduction in inequality within rural areas and between rural and urban areas, even though urban inequality rises. Simulations also show that additional public expenditure to enhance the progress in adult education only accelerates these labour market and income distributional outcomes.

## Structural Changes in the Indian Economy: An Input Output Multiplier Analysis

Topic: 811D  Special session: Modeling Impacts of Structural Change in Emerging Economies (2)
Author: Ganesh Kumar ANAND
Co-Authors: Manoj K. PANDA

The Indian economy has undergone substantial changes in recent decades. In particular, it is more closely integrated with rest of the world since 1990s. This paper aims at a discussion of major structural changes over time since early 1980s in various final demand elements and technology matrix in the India. Against this backdrop, it will analyse intersectoral linkages among different sectors as well as impact of changing demand pattern on the economy. It will thus examine questions such as changing pattern of linkages between domestic sector and external sector due to stronger integration of the Indian economy with the rest of the world; for example, an interesting question to explore is: how a one percent volume growth in the export basket has influenced the domestic production and import structure over the years.

The input-output tables for India have been published by the Central Statistical Organisations

(CSO) for the years 1983-84, 1993-94, 1998-99 and 2006-07. This will be the main data source for the paper. In order to enable comparability, these tables will be aggregated to about 25 common sectors and the analysis will be carried out at this level of disaggregation. The paper will discuss how the demand pattern in the economy is changing across final demand elements and across sectors. Estimation of backward and forward linkage multipliers (both Rasmussen and Ghosh type) will help in understanding strength of linkages between sectors in different time periods.

The paper will then examine the effect of a 1% change in different final demand vectors. More specifically, the paper will focus on relative effects of domestic and external demand on output and income of different sectors. Such comparative static experiments for different years will be interesting in the context of the structural changes the economy has witnessed in recent decades. This part will form the novelty of this paper.

Note: A new input-output table for a more recent year is likely to be released by the CSO soon. If it is available before the completion of the paper, we shall use this data too.

## Evolution and Impact on its economy of the Chilean trade with Asian countries.

Topic: 716D Special session: Asian Trade with Latin America: Impact and Evolution
Author: Patricio AROCA
Co-Authors: Nicolas GARRIDO

There has been an increasing trade among Chile and Asian countries. This trade might be characterized by exporting row materials from Chile and importing manufactured goods from Asian countries. How much had been the impact of this trade over Chile through the recent years is something that has not a clear answer and this paper aims to answer at least partially this question.
The methodology will rely in using the recent multicountry input-output table built for ten Latin American countries and the rest of the world. Part of this paper, separate the Asian countries from the rest of the world in order to have a better estimation on the impact and the evolution of the trade.
In addition, the matrix is estimated around year 2005, which is the middle of strong increase in the copper price, one of the main Chilean production that account for more than 50 percent of the exports.
The data used in the paper come from the Chilean Central Bank and the matrix is the one produced by ECLAC and IPEA from Brazil.
The results shows that Asian countries have a large and growing impact on the Chilean economy, especially in the period where the cooper price is increasing, and this effect is significant reduced when the price goes down.

# Statistical assessment of the top-down and bottom-up approaches for the construction of regional input-output tables

Topic: 811A  Regional IO Modelling (2)
Author: Normand E ASUAD

Traditionally, regional Input-Output tables are constructed from the national Input- Output matrix; this is known as the "top-down" approach and it is considered as an essential tool for the construction of regional Input-Output matrices.

Furthermore, the approaches that emphasize the importance of the hybrid methods, that recommend the combined use of regional and national data, do not take into account the importance and impact of the location of economic activities and their differentiation in economic interaction on the economic performance of the regions.

Even more, if there is any emphasis to the economic importance of the regions within countries, it is usually associated with administrative political entities: states, municipalities, provinces or counties, regardless of the existence of functional economic regions, which are characterized by how the economic activity is spatially structured and how it behaves functionally, regardless of the political-administrative units.

In the literature related to the construction of regional Input-Output matrixes, some researchers insist on the need for a greater extent of regional information using hybrid methods that combine both regional and national information for the construction of regional Input-Output tables, without taking into account the location and the spatial economic functioning of the economic activity which is manifested through the formation of a spatial economic structure, with different degrees of integration.

Hence in this study, we pretend to make a comparative analysis of the approaches "top-down" and "bottom-up" for the construction of regional Input-Output tables, for the State of Sonora, Mexico as well as their statistical assessment.

Therefore, the methodology consist of three stages: In the first, using the "top -down" approach the regional matrix of Sonora is constructed, using the regional specialization coefficients of Flegg, Flegg, Webber & Elliot (1995, 1996); this takes into account the relative size of both the seller and buyer sectors as well as the regional specialization, in order to estimate the matrix of economic transactions as well as the matrices of the technical and total coefficients.

The second stage is related to the construction of the regional matrix using the "bottom-top" approach, through the identification and delineation of the economic functional sub regions. Afterwards, their spatial dependence is validated through spatial econometrics analysis. Subsequently, we create the matrices of the regional economic transactions, and the technical and global coefficients matrices by economic subregions, adding them together in order to create the table of Sonora ´s multisubregions

Finally, the last stage has to do with the statistical assessment of the regional Input-Output matrix, which is derived from the national matrix, but also the regional one, which is based on the functional economic approach. It is worth to mention that the main orientation of this analysis is to look for differences between the methods, in order to show how the economic region is modeled by both approaches and to give an immediate picture of possible implications, in terms of their impact on the regional economy, according to the regionalization method selected.

This study was made with the use of the national Input-Output matrix of 2008 and with the data given by the 2008 census, which had information available by state. The missing information came from estimates using information given by the government and from the use of indices of interaction validated by spatial econometrics.

## Import Dependency of Turkish Economy and Major Determinants in Sectoral Level: An Input Output Analysis

Topic: 814D  Region/country-specific Analysis
Author: Necla AYAS

Since production and trade structure has been changing in globalization economic area, even if production and exports increases, economic impacts of them cannot be always positive. This is also valid for Turkish economy. Despite growing output and exports volumes, maintaining problems such as unemployment, foreign trade and current account deficits shows that Turkish economy hasn't been taken advantage of foreign trade benefits. One of the basic reason of this situation is substitute import inputs for domestic inputs caused multiplier mechanism to diminish.

Many efforts have been devoted to import dependency of economies. In this study, import effects of sectors and their determinants have been researched by using input output models. Main determinants of sectoral import dependency were classified as base of three elements such as intensity of imported input, share of sectors in output and inter sectoral linkages. By the use of National Turkish Input-Output Tables from 1995 to 2011 which have been published World Input Output Database, import dependency of Turkish Economy was examined by sectors.

Keywords: Input Output Analysis, Import Dependency, Turkish Economy.

## Input Output Linkages and Agglomeration: Evidence from Turkey with Panel Data Analysis

Topic: 809X  IO Analysis for Policy-making (1)
Author: Necla AYAS
Co-Authors: Aykut SARKGUNESİ

The inter-dependencies among sectors through input–output linkages drive co-agglomeration of related sectors in the same locations and accelerate agglomeration of economic activities in some areas. Although there are numerous studies to investigate the factors affecting the agglomeration, very few studies have examined the relationship between agglomeration and input output linkages in the regional development literature.
Glaeser and Kerr (2007) researched importance of both forward and backward linkages on location decision of firms. Sohn (2004) examined spatial distribution pattern of manufacturing activities associated with intra-industrial advantage (localization economies) and inter-industrial benefit (urbanization economies). Stressing the importance of intermediate input intensity, Rosenthal and Strange (2001) draws attention to the backward linkages for agglomeration. Ellison, Porter (1990, 1998) also asserts that the input-output linkages between industries encourage interrelated industries to co-locate in some regions and promote industry agglomeration. Smith and Florida (1994) examined the co-location of backward and forward

linked manufacturing enterprises in automotive-related industries in the process of industrial location.
In this study, we investigate whether input-output linkages drive agglomeration. We used Localization Quotation (LQ) coefficient (as indicator of agglomeration), forward, backward and inward (we used this term to imply intra industry) linkages as main variables of study. Transportation costs, taxes and subsidies which accepted factors to encourage agglomeration also included in the model. We try to apply as new econometric methods as we can. We considered all applications to test if there is cross-section dependency between panels and heterogeneous slope coefficients across group members. We use a balanced panel data set that covers 20 aggregated industry groups in Turkey for the period of 1995-2011. Turkey Input Output Tables and some socio economic accounts which are required to achieve goal of this paper were obtained from WIOD database.

Key Words: Agglomeration, Input Output Linkages, Panel Data Analysis.

## Changes in the Brazilian Productive Structure and Economic Growth During the Great Recession

Topic: 514B  Structural Decomposition Analysis
Author: Carolina T. BALTAR

Brazil achieved a period of relatively high economic growth from 2004 to 2008, after a long period of unstable and low economic activity. This short period of improved performance was achieved when the world scenario was favourable for the performance of the Brazilian trade balance due to rising commodity prices and growing external demand. In this setting, Brazilian exports increased considerably, followed by rises in domestic GDP, manufacturing GDP, consumption, gross fixed capital formation and imports. The Great Recession that emerged after the financial crisis of August 2007 brought challenges to the Brazilian manufacturing industry, with consequences for the country’s GDP growth. Brazil has an important and diversified industry, especially compared to other Latin American countries, and its performance has an important role to play on the Brazilian economic activity. The outcome after the Great Recession is lower manufacturing GDP and considerably higher imports. A recent debate on the difficulties to boost the Brazilian economy stresses the problem of currency appreciation and favourable prices for production and exports of commodities. According to some authors, the high competitiveness of these commodity sectors would generate excessive surplus in trade that, together with high capital inflows, would promote appreciation of the national currency and increase the disadvantages of the manufacturing sector in terms of the external competition. The low dynamism of the manufacturing production would then explain the lower GDP growth.

The aim of this paper is to investigate the changes occurred in the Brazilian productive structure in the period after the emergence of the Great Recession, when Brazil was not able to sustain its previous GDP growth rates, in relation to the period after 2003, when the country’s economic performance improved. For this purpose, we use the input-output structural decomposition analysis (SDA) applied to the data provided by the World Input-Output Database for the case of Brazil between 2003 and 2011. More specifically, the objective is to decompose the production variation and verify which component (intermediate consumption or final demand) caused the change in each economic sector's output over the period of investigation. This is the standard analysis of the SDA literature and we improve it further by including a disaggregated study of the causes of changes in imports in the relevant sectors.

The results, then, contribute to a better understanding of the changes in the relevant sectors' products, the impact of imports and their consequences for the country's GDP; thereby providing further evidence and explanation of the poor performance of the Brazilian manufacturing sector and GDP growth.

## Assessing the Accuracies of the Modified FLQ visa-viz CHARM in Generating RIOTs: Case Study of Gilan Province, Iran

Topic: 809A  Regional IO Modelling (1)
Author: Ali A. Banouei
Co-Authors: Sharareh Kavoosi, parisa mohajeri, narges sadeghi

Using the prevailing non-survey methods to estimate the RIOTs has been a common practice in Iran. Due to the lack of survey-based RIOTs in Iran, the reliabilities and accuracies of the estimated tables have been the major concerns both for the researchers as well decision makers at the regional. The main aim of this article is to empirically investigate these concerns. For this purpose we attempt to use a modified FLQ formula which is prone to Cross-Hauling and CHARM which explicitly takes into account of Cross-Hauling to estimate the RIOTs of Gilan Province. Then on the basis of statistical methods, we assess the accuracies of the estimated tables with the currently available survey-based table. The overall results reveal that as compared to CHARM, the modified FLQ formula overestimates the sectoral output multipliers of Gilan province.

## Estimation of Government Spending Multipliers for Russian Economy

Topic: 811X  IO Analysis for Policy-making (2)
Author: Alexander O. BARANOV

The article examines the impact of growth in public spending in Russia on the dynamics of macroeconomic and sectoral indicators using econometric techniques and dynamic input-output models.
Up to now, an ongoing debate about the effectiveness of public spending as a way to stimulate economic growth. The Keynesian point of view is that the economic multiplier is greater than unity. However, it is known assertion disputed by the new classical school (Barro Robert J., Redlick Charles J. Macroeconomic Effects From Government Purchases and Taxes // The Quarterly Journal of Economics. – 2011. – p. 51-102). Representatives of the new classical school argue that in many cases the economic multiplier is less than one. In their opinion economic growth more effectively stimulated by tax cuts.

System of government spending multipliers in Russia obtained using econometric analysis
1. For the study were allocated 6 main indicators of public spending:
- Nationwide Issues;
- National economy;
- Housing and utilities;
- Environmental protection;
- 'National defense' + 'national security and law enforcement ";
- Social spending, which includes spending on education, social policy, culture, cinema, media, health care, physical culture and sports.
2. Calculations have been performed using data with the annual step (1995-2013) and quarterly

step (2004-2014).

Main conclusions on the results of econometric calculations.

- As a result of the econometric analysis was not found statistically significant dependence of growth of Russia's GDP from government spending for annual data and quarterly data. Therefore, on the basis of econometric analysis could not determine the multiplier of government spending for GDP of the Russian economy.
- Impact of growth of different types public spending on the growth of gross output and VA growth in various economic activities is contradictory. In some cases the results of calculations for quarterly and annual data contradict each other.

Conclusions on the results of calculations using the Dynamic Input-Output Model

1. Multipliers of government spending increase for gross output of the Russian economy in all analyzed items have values greater than one. This confirms the effectiveness of Keynesian ideas to stimulate economic growth by increasing public spending on final goods of construction, machine building (including defense spending), health care, education, research and development. The highest multiplier effect is achieved with an increase in construction costs (the value of the multiplier in 2014 is equal to 2,4), the lowest - at increasing expenditure on research and development (the multiplier in 2014 equal to 1,5). It should be noted here that the expenses on research and development have an impact on economic growth in the long term and the full effect of their increase may occur much later.
2. Negative impact of growth in public spending on production of a number of sectors (construction, machine-building, research and development) on the dynamics of the gross output of the second subdivision is explained by two factors a) the redistribution of resources in favor of industries producing goods and services primarily for production purposes; b) the fact that the increase in production requires a new fixed assets, which are created in industries that produce primarily first division products.
3. It was assumed in this study that public spending increase needs not only increase of production of any industry, but also needs increase of the corresponding inputs of capital assets. Because of this assumption the most significant multiplier effects associated with fixed-assets building industries. Such multiplier effect can be expected in a situation when the economy does not have adequate reserves of production capacity by economic activities, the demand for products of which from the state increases significantly.
4. Type of economic activity, for the purchase of products of which have been directed additional public spending, in addition to the fixed-assets building industries provide the greatest increase in gross output. For example, if the increase in public spending has been directed to education, the gross output of the industry in 2014 increased by 1,427 times, which is the highest value among all other economic activities, except for machine-building.
5. As a result of calculations were determined the multipliers for some major directions of public spending. It is shown that the acceleration of economic growth in the short and medium term most effectively provided through the growth of government spending on construction and machine-building products, including defense products. These economic activities have the highest multipliers throughout the forecast period.

The novelty of the results consists in the comparison multipliers of government spending in the economy of Russia, obtained using econometric methods and dynamic input-output model.

## Assessing the importance of international tourism for the Iran economy: A social accounting matrix approach

Topic: 809Y  Tourism Industry Analysis
Author: Fatemeh BAZZAZAN
Co-Authors: atefe farahani

International tourism has developed rapidly on the global scale since the late 1970s. According to the United Nations World Tourism Organization (UNWTO), International tourist arrivals have increased from 25 million globally in 1950, to 278 million in 1980, 527 million in 1995, and 1133 million in 2014. Likewise, international tourism receipts earned by destinations worldwide have surged from US$ 2 billion in 1950 to US$ 104 billion in 1980, US$ 415 billion in 1995 and US$ 1245 billion in 2014. International tourist arrivals worldwide are expected to increase by 3.3% a year between 2010 and 2030 to reach 1.8 billion by 2030, according to UNWTO's long term forecast Tourism towards 2030. Between 2010 and 2030, arrivals in emerging destinations (+4.4% a year) are expected to increase at twice the rate of those in advanced economies (+2.2% a year).The market share of emerging economies increased from 30% in 1980 to 45% in 2014, and is expected to reach 57% by 2030, equivalent to over 1 billion international tourist arrivals. Based on the current trend and this outlook, UNWTO projects international tourist arrivals to grow by 4% worldwide in 2016.

Iran's International tourism has grown since the mid-1990s. Over the past 18 years، The number of arrivals have been grown 1.34% in 1995-2013 period, and the income receipt  have increased 2.4 yearly. Tourism could be recognized  the largest service industry in terms of revenue in the future. So, the tourism sector could bring a lot of social and economic changes. Iran's tourism industry looks set to grow rapidly following the lifting of economic sanctions, with more westerners looking to visit and plans being made for the development of tour companies, hotels and tourist facilities.
The main purpose of this paper is study the impact of international tourism on the Iran economy. For this purpose we need to answer to these following questions: (i) to what extent did international tourism contribute to GDP in Iran? (ii) to what extent did international tourism contribute to employment growth in Iran? (iii) through what sort of intersectoral relations did international tourism contribute to employment and GDP? To this end, two SAMs for 2006 and 2011 are applied.

## Modelling the interest payments and receipts of households and non-financial corporations in the euro area

Topic: 716A  Special session: Flow of Funds Data and its Applications (2)
Author: Louis BÊ DUC

The very low interest rates in the euro area (similar to the rest of the world) have triggered a sharp decline in the interest rates flows in the in recent years. In this context, it appears useful to assess the sensitivity of households and non-financial corporations' balance sheets to changes in interest rates. This paper aims thus at modeling the interest payments and receipts of households and non-financial corporations. For that purpose, it combines data available from financial accounts, MFI balance sheet, market or retail interest rates for the euro area in order to build a simplified balance sheet of sectors structured according to its sensitivity to interest rates changes.

## How Do GVCs Affect Shock Transmission across Borders?

Topic: 516W  Special session: Global Production Networks: Theory and Empirics (2)
Author: Rudolfs BEMS

This paper examines the role of GVCs in cross-border shock transmission. We start by extending a conventional IRBC model to allow for intermediate inputs and parameterize the model to replicate allocations of a global input-output table. We then compare model responses to a set of shocks in the conventional IRBC and our extended models. The focus is on global and regional spillovers from shocks in key economies, such as the USA and China. We quantify differences in spillovers between the two models – conventional and extended IRBC -- in terms of both response magnitudes for key variables (e.g., GDP, labor input and wages) as well as welfare implications. To keep the results tractable, shocks are initially modeled as changes in wedges (e.g., labor wedge), as defined in the business cycle accounting literature. Subsequently, our findings are extended to a richer model setting with monetary policy shocks, i.e., the conventional NOEM model. Preliminary results suggest that explicit modeling of intermediate inputs can significantly alter shock transmission across borders. We find, for example, that the beggar-thy-neighbor logic of currency wars need not hold when countries are integrated in production chains.

## The Impact of Contract Enforcement Costs on Outsourcing and Aggregate Productivity

Topic: 514W  Special session: Global Production Networks: Theory and Empirics (1)
Author: Johannes BOEHM

Legal institutions affect economic outcomes, but how much? This paper documents how costly supplier contract enforcement shapes firm boundaries, and quantifies the impact of this transaction cost on aggregate productivity and welfare. I embed a contracting game between a buyer and a supplier in a general-equilibrium closed-economy Eaton-Kortum-type model. Contract enforcement costs lead suppliers to underproduce. Thus, firms will perform more of the production process in-house instead of outsourcing it. On a macroeconomic scale, in countries with slow and costly courts, firms should buy relatively less inputs from sectors whose products are more specific to the buyer-seller relationship. I first present reduced-form evidence for this hypothesis using cross-country regressions. I use microdata on case law from the United States to construct a new measure of relationship-specificity by sector-pairs. This allows me to control for productivity differences across countries and sectors and to identify the effect of contracting frictions on industry structure. I then proceed to structurally estimate the key parameters of my macro-model. Using a set of counterfactual experiments, I investigate the role of contracting frictions in shaping productivity and income per capita across countries. Setting enforcement costs to US levels would increase real income by an average of 7.5 percent across all countries, and by an average of 15.3 percent across low-income countries. Hence, transaction costs and the determinants of firm boundaries are important for countries' aggregate level of development.

## Using labor footprints to investigate the self-sufficiency of labor in autarky

Topic: 711X  Employment Analysis (1)
Author: Timon I. BOHN
Co-Authors: Erik DIETZENBACHER

We use the World Input-Output Database and the ‘labor footprint’ concept to gain new insights into the implications of trade for employment. Using the United States as an example, but also examining 39 more countries, we determine that production for US consumption depended more and more on contributions of foreign workers between 1995 and 2008. We then compare labor footprints with labor endowments to evaluate the capacity of countries to be self-sufficient in labor in a situation of autarky. Labor footprints allow us to identify the amount of labor worldwide necessary to sustain the consumption pattern and standard of a particular country. Labor endowments reflect that country’s workforce plus unemployed workers.

The counterfactual exercises, which account for differences in production technologies and worker productivities across countries, reveal that most countries are able to produce all output for consumption themselves. This means that these countries are able to produce at least as much output in autarky as the output each country consumed in actually observed trade structures. This suggests that gains from trade may not be apparent in labor use. Once the assumption of zero unemployment and perfect labor mobility is dropped, self-sufficiency prospects were lower. Furthermore, the ability of countries to be self-sufficient declined over time.

## Estimating Trade in a Regional Input-Output Table

Topic: 814A  Regional IO Modelling (3)
Author: Johannes BROECKER
Co-Authors: Johannes BURMEISTER

This paper provides a new hands-on recipe for regionalizing national Input-Output (I-O) tables. While the theoretical grounds of existing non-survey regionalization methods are questionable, we develop a method which is both, theoretically well-founded and consistent with national accounting principles. We derive a regional trade equation that estimates sectoral internal trade and thereby sectoral exports and imports. The trade equation is derived as the equilibrium solution of a 2-regions (small region and rest of world) trade model with CES preferences and symmetric trade barriers. It shows how internal trade depends on the region's output and use as well as on its internal trade barrier. The latter is approximated by combining known national data with easily accessible information of the region's geographical size. We call the method “Gravity Regionalization of Trade Approach" (GRETA). Unlike other non-survey methods, GRETA's trade equation fulfills the constraint that internal trade is non-negative and does not exceed either the region's domestic output or use. We show that, according to the formula, internal trade is increasing in both, domestic output an domestic use, and that it increases more than proportionally if output and use increase pari passu. Furthermore, trade is decreasing in the internal barrier. At the extremes, it goes to zero if the barrier goes to infinity and to the minimum of output and use if the internal trade barrier goes to zero. After providing GRETA's easy to use regionalization recipe, we take our approach to the data and test it with regional I-O survey data for Finland, China and Japan. We find that GRETA generally performs well in estimating sectoral trade, although the performance differs across sectors and regions. Finally, we also compare our

estimation results with commonly used methods like the “Cross-Hauling Adjusted Regionalization Method" (CHARM) by Kronenberg (2009) and find that GRETA generally outperforms its competitors. Like other methods, GRETA also tends to overestimating regional output multipliers, but less so than other regionalization methods. The empirical application also shows that CHARM produces negative sectoral trade values in certain cases, which cannot happen with GRETA.

## Flow-of-Funds Analysis in Brazil: Applying Input-Output Analysis Methods

Topic: 711A  Special session: Flow of Funds Data and its Applications (1)
Author: Erika BURKOWSKI
Co-Authors: Jiyoung KIM

In this paper, we apply concepts of Input-Output Methodology on the Assets and Liabilities Matrix (ALM) to show the Flow-of-Funds (FOF) between agents in Brazilian economy. Proposed by Copeland (1952), the ALM adopts a quadruple entry system, logically developed from double entry accounting system, the financial assets and financial liabilities data came from the Balance Sheet of institutional sectors. As a square matrix, the ALM tabulation allows to use all the basic principles of modern accounting system to analyze the structure of financial flows in the economy and its effect on the flow of the real economy. Tsujimura and Mizoshita (2003, 2004) improved the FOF analysis, and this methodology has been used to study financial flows in Japan. The method has also been applied in studies for the economy of Korea (Kim, 2014), and has shown to be a powerful tool to analyze the domestic financial market. The contribution of this work is to show the effect of the financial transactions of economic agents in Brazil. Since the recent financial crises have been adversely affected on the product and on the growth of developing economies, we stimulate discussion on the subject and guide to search for more effective action, which will be regarded as the main contribution of this analysis.
The results indicate how “make and use" of financial resources affect the flow of capital in the economy and how the monetary policy which is established by the Central Bank of Brazil generates a greater spreading of resources in the economy. Since there are not any applications with similar approaches in Brazil, this study can be an important source of information for the future researches, evaluations and formulations of economic policies.
The link between the activities of the real economy and financial market transactions can be viewed through the economic flows. Therefore, Excess Financial Assets and Excess Liabilities in the Financial Accounts indicate respectively Investments and Savings in Non-Financial Accounts (Real Economy = transactions of goods and services + income transfers). In this sense, it is interesting to investigate the movements of financial accounts to understand its impact on the real economy. Moreover, policymakers will be able to refer to the results of this simulation as indicators to their decisions and policies. From this point of view, we intend to answer the following questions: Does the need for financing or excess resources of a given economic agent affect the flow of total capital in the Brazilian economy? Does the use or availability of surplus funds by an economic agent influence the movement of the cash flows of another economic agents? Do changes in monetary policies implemented by the Central Bank of Brazil encourage growth or shrink the economy? Has been the Central Bank of Brazil conducting monetary policies effectively? We built the financial transactions table of institutional sector-by-institutional sector using Brazilian data in 2005, which is composed of 6 institutional sectors or economic agents: Households, Government, the Central Bank, Financial Companies (excluding the Central Bank), Non-Financial Enterprises and external sector (Rest of the World). The Power of Dispersion Index (PDI) and Sensitivity of Dispersion Index (SDI) are calculated using Leontief Inverse matrix. These indicators show how the flow of funds spreads through the economy when one agent raises more

funds or when it has excess of funds. Subsequently, we examine the monetary policy evaluations. In this model, the Central Bank of Brazil is treated as an exogenous sector. The net savings of the other agents in the economy which are induced by the Central Bank are calculated. The data of “Financial Sheet Accounts” published by the Central Bank of Brazil and the Brazilian Institute of Geography and Statistics (IBGE), the “Balance Sheet of the Central Bank of Brazil” announced by the Central Bank of Brazil are used for this analysis. Preliminaries results of DPI and SDI in 2005 demonstrate that "Households" sector shows the feature of representative “Savings Sector” with little scattering influence on the flow of funds. The "Financial Companies without the Central Bank" and "Non-Financial Enterprises" displays characteristics of representative "Investors Sectors", since they show greater power of indices in the liability-oriented system and lower dispersion-power indices in the asset-oriented system. This result highlights the low influence of the Financial Companies of their financial investments. Both the Government and the Central Bank demonstrate high dispersion indices. It indicates that these sectors stimulate financial transactions throughout the economy when their additional fund raising or fund employment is increased.

## Economic impact assessment of food waste on European countries throughout Social Accounting Matrices

Topic: 711C  Social Accounting Matrix
Author: Pilar CAMPOY-MUÑOZ
Co-Authors: Manuel A. CARDENETE, María C. Delgado

Food waste is becoming a major global issue, which threats a sustainable food system and generates negative externalities in environmental terms. From an economic perspective, studies focus on estimating the amount and monetary value of the wasted food by households and along the supply chain, in order to highlight the associated cost to the society. In this paper we adopt a different point of view, assessing the effects of food waste reduction on national economies in terms of total output, GDP and employment. To do this, we use linear multiplier models based on Social Accounting Matrices with a highly disaggregated agricultural account for the year 2007. The proposed methodology is applied to a sample of European countries with different economic structure, i.e. Spain, Germany and Poland. The results show the greatest impacts are due to a reduction on the avoidable portion of the wasted food by household across the countries.

## Youth unemployment in Europe:  The North-South divide interpreted using a bi-regional demoeconomic model

Topic: 516B  Special session: The Use of Open, Semi-Closed and Closed IO Models; Theory and Application
Author: Andre CARRASCAL
Co-Authors: Geoffrey J.D. HEWINGS

According to the European Labor Force Survey (LFS), in 2013, the youth unemployment rate reached 23.3% for Europe. The analysis of this issue gains a special relevance due to the important differences existing between the Member States. Northern countries like Germany (7.9%) or the Netherlands (11.0%) have very low rates in comparison to Southern countries such as Greece and Spain that reach dramatic levels of 58.3% and 55.5%, respectively. The main aim of this paper is to assess for the principal macroeconomic consequences of the youth unemployment in both the North and the South of Europe. Using the information available in the

WIOD for the year 2011, a bi-regional demographic I-O model is proposed. Working with a extended I-O model allows us to account for household and government induced effects, capturing the circular flow of income in an economy. Data provided by the Households Expenditure Survey was also exploited to disaggregate the different household considered. Therefore, simulating an increase in youth unemployment, i.e. excess in labor supply, several positive and negative effects can appear depending on the productive structure of each economy. Through a government channel, it would cause an increase in total unemployment benefits and, subsequently a decrease in the government expenditure. From the final demand channel, the sign of the effect would depend on the composition of the consumption of the youth employed and youth unemployed. Finally, all of these effects would have an additional impact on the labor market, which can cause a vicious cycle of unemployment creating unemployment.

## NAFTA Trade in Value Added and its distribution, 1995-2011

Topic: 516X  Regional Trade Agreement and Trade Governance
Author: Rosario CERVANTES
Co-Authors: Jorge Ignacio Villaseñor - Becerra

The trade deficit of the United States with his NAFTA partners, Mexico and Canada, increased since 1994 from 21,991 to 119,257 million dollars in 2013 (UNCOMTRADE, 2015), most of this increase it is explained by  the growth in the volume of commerce between Mexico and the United States. Nonetheless, since the mid - 1990s Mexico has been experiencing its lowest economic growth rates. By using the WIOD (Timmer, Dietzenbacher, Los, Stehrer, and de Vries, 2015) and the Input-Output Analysis this paper presents an estimate of the intra-NAFTA trade flows in terms of value added and its distribution among both labor and capital; and labor by skills level. So far, the findings show that trade between the NAFTA members it is quite different concerning value added. In 1995 the United States had a trade deficit of 30,351 million dollars with Canada, of which 6,384 million dollars were a surplus in favor of Canada in terms of value added. Similarly, the same year the United States had a deficit of 4,276 million dollars with Mexico that became a surplus for the latter of 4,561 million dollars in terms of value added. For the year 2000 and 2011 a similar pattern is observed. The aim of the paper is to show how the trade in value added and its distribution between capital and labour can help us to explain the poor economic performance of some economies.

## A Web-Based Regional Economic Simulation Tool for U.S. Army Corps of Engineers' Civil Works Program

Topic: 809X  IO Analysis for Policy-making (1)
Author: Wen-huei CHANG
Co-Authors: Yue Cui, Ed Mahoney

The U.S. Army Corps of Engineers (USACE) is one of the world's largest public engineering, design, and construction management agencies, and its civil works mission areas include navigation, flood risk management, hydropower, water supply, recreation, and environment. To be able fully capture the economic benefits of its water infrastructure and programs for policy and decision making purposes, USACE Institute for Water Resources (IWR) has developed the REgional ECONomic System (RECONS) that aims to provide accurate and defensible estimates of regional and national jobs and other economic measures such as income and sales associated with its civil works activities. Economic impacts and contributions are estimated for two types of

economic activities associated with USACE programs: 1). Direct federal spending on infrastructures and operations and maintenances and 2). Other economic activities resulted from the primary users of infrastructure constructed and maintained by USACE. The full contribution of these activities to the economy is estimated using Input-Output modeling techniques, and includes linkages back to the industries, businesses, and households supplying the goods, services, as well as the household spending recalculated to the region's economy.

RECONS is a web-based dynamic simulation system, and is developed with PHP/MySQL applications with the server hosted on Cloud Computing Services. RECONS also utilizes mapping function which allows users to portray the areas benefited by USACE programs. There are currently more than 1200 built in regional I-O models that correspond to USACE's civil works mission areas. Multipliers and other economic ratios and factors are from IMPLAN, US Bureau of Economic Analysis, and Bureau of Labor Statistics. This tool is designed for easy accessibility while in a controlled environment. It also allows frequent modifications/updates and new add-ons to be made through the server and instantly distributed. This tool provides a more convenient and consistent way to estimate jobs and conduct economic impact analyses including the effects of either increased and decreased expenditures by the government, while enables users to conduct valid and reliable economic impact analyses, even those with little experience in Input-Output analysis required by IMPLAN or other comprehensive I-O models. The users can also simultaneously estimate economic impacts at different geographic scopes (e.g., local, state, national) and to aggregate those impacts across various political boundaries. It also increases rigor and consistency (e.g., spending profiles, identification of impact areas) in the manner in which economic impact analyses are conducted by the USACE. As a result, over 80 USACE economists from various mission areas across the country have used this simulation tool and conducted over 5,000 analyses for USACE related economic activities. This paper will describe the capabilities and applications of RECONS, and its implications for federal and local government funding and resourcing policies and decision making processes.

## Exploring transnational city carbon footprint networks with the Industrial Ecology Virtual Laboratory

Topic: 814W Special session: Input-Output Virtual Laboratories (2)
Author: Guangwu CHEN
Co-Authors: Yafei WANG, Thomas O. WIEDMANN

Cities are leading actions against climate change through global networks. More than 360 global cities announced during the 2015 Paris Climate Conference that the collective impact of their commitments will deliver over half of the world's urban emissions reductions by 2020. Previous studies on multi-city carbon footprint networks using sub-national, multi-region input-output (MRIO) modelling have demonstrated a greater opportunity for addressing the negative impacts of climate change through joint actions between cities in a country. However, similar links between city carbon footprint have not yet been studied across countries. In this study, using data from the Industrial Ecology Virtual Laboratory (IELab), we develop a multi-scale, global MRIO model to describe a transnational city carbon footprint network among the four Chinese province-level municipalities and the five largest Australian capital cities. We firstly assess the emissions embodied into the bilateral trade driven by urban demand for goods and services. Furthermore, we present a city emissions 'outsourcing hierarchy' based on the balance of emissions embodied in intercity and international trade. This is juxtaposted with the typical pattern of national territorial emissions and carbon footprints. We explore the policy implications for transnational city emissions mitigation by investigating scenarios for low-carbon bilateral

trade under the background of the China-Australia Free Trade Agreement. Furthermore, we evaluate and discuss opportunities for matching China's regional pilot carbon trading schemes with the ambition of Australian cities to claim carbon neutrality. Finally, we discuss the prospect of Chinese and Australian cities pioneering joint actions to meet the Compact of Mayors agreement of the Paris Climate Conference.

## The semi-closed input-output model and its application to income policy analysis

Topic: 516B  Special session: The Use of Open, Semi-Closed and Closed IO Models; Theory and Application
Author: Quanrun CHEN
Co-Authors: Albert E. STEENGE

In the open input-output model, all final demand categories (such as household consumption, government consumption, capital formation, and export) are treated as exogenous variables and therefore assumed mutually independent. This treatment, however, may yield problematic outcomes. For example, the open input-output model implies that increased government consumption may lead to decreased household consumption per worker.
Semi-closed models can be used to tackle the problem by endogenizing household consumption together with labor input. However, we may find that this only partly solves the problem, since other final demand categories are still treated as exogenous variables. To completely solve the independent problem, we develop a variant in which a selection of final demand categories is endogenized together with their corresponding factor inputs. As an application of the model, we investigate the impact of income policy on the Chinese economy, an exercise that is difficult to accomplish in standard input-output modeling.

## Skills and Activity Upgrading in Global Value Chains: Trends and Drivers for Asia

Topic: 716E  Special session: SIC-OECD-IDE/JETRO Joint special sessions on Development, Employment and Inequality (2)
Author: Quanrun CHEN
Co-Authors: Gaaitzen DE VRIES

This paper examines the macro-dynamics and drivers of upgrading by Asian countries in Global Value Chains (GVCs). We examine the main trends in skill and activity upgrading in GVCs using the newly constructed ADB Multi-Region Input Output Tables as well as occupation data on jobs by educational attainment and business activities, namely R&D; production; logistics, sales and marketing; administration and back-office; and headquarter. Our results suggest there is an ongoing specialization process in high-income Asian countries and in Developing Member Countries (DMCs) towards high-skilled and more knowledge-intensive activities. The pace of upgrading differs across Asian countries, being more rapid and encompassing in China in comparison to Bangladesh and India. We use a structural decomposition method to account for the drivers of the trends observed. In particular, technological change in global value chains that is biased towards skilled activities is important in accounting for the trends observed.

## Assessment of CO2 Emissions Change in Eastern Asia: A Multi-Regional Structural Decomposition Approach

Topic: 514B  Structural Decomposition Analysis
Author: An-yi CHIN
Co-Authors: Hao-chuan YANG

Due to the unstable political situation in Middle East, and large-scale exploitation of shale gas in United States, fossil fuel prices fluctuate dramatically. Besides, the continuous deterioration of global climate also awakes authorities to seriously concern various ways such as promoting renewable energy, taking several CO2 emissions reduction policies and improving energy efficiency to mitigate the impacts. So, observing CO2 emissions trends now become to be an important work. This paper aims to identify the driving forces of change in CO2 emissions, we use structural decomposition approach (SDA) and World Input-Output Database (WIOD) to uncover the disparities in Eastern Asia and trace the change of embodied CO2 emissions during 1999 to 2009 by the effects of emission intensity, primary energy intensity, and energy efficiency. This study provides a broad overview of the magnitude and distribution of the drivers for embodied CO2 emissions across countries, and offers insights for policy makers to formulate a comprehensive and sector-specific energy policy to sustain economic growth.

## The Global Production Line Position of Chinese Firms

Topic: 514W  Special session: Global Production Networks: Theory and Empirics (1)
Author: Davin CHOR
Co-Authors: Kalina Manova, Zhihong YU

A key trend in international trade over the last two decades has been the rising fragmentation of production across countries. We use firm-level customs data, matched manufacturing census data, and Input-Output tables from China, to better understand where and how Chinese firms operate along the global value chain. We characterize each firm's global production line position by computing the upstreamness of each firm's export and import mix, using a measure of upstreamness that reflects the number of production stages between the product mix in question and final uses. We document the evolution of Chinese firms' global production line position over the 1992-2011 period. We also show how it correlates with firm performance (total exports, sales) and with various underlying firm characteristics (ownership, productivity, capital and skill intensity).

## Measurement of Total Labor Productivity Growth by using Eora MRIO and OECD WIOD

Topic: 714D  Productivity and Efficiency (2)
Author: Yanjuan DAI
Co-Authors: Hiroshi IZUMI, Jie LI

1. Introduction

We measure productivity growths of China, Japan, South Korea and others by using the indicator of total labor productivity (TLP, ratio of output to total labor). Total labor includes direct and indirect labor. Indirect labor means labor used for production of raw material, machine etc. As an indicator of productivity growth, the TLP is better than TFP (traditional total factor

productivity) in respects that TLP is productivity which includes fixed capital efficiency growth and that TLP can be measured regardless of competition condition etc.

Until the last paper, we measured TLP by using national input-output tables. In this paper we will measure TLP by using international input-output tables and will compare that results with the results used national input-output tables.

The research questions are improvements in method for mesurement of productivity growth and more accurate mesurement results of productivity growths of China, Japan, South Korea and others.

## 2. Method

We will calculate productivity growth rates of China, Japan, South Korea and others in the following way.

2-1 First we calculate total labor quantity per a unit price of product by using national input-output tables. Here fixed capital consumption and gross fixed capital formation are endogenous sectors.

In this calculation, total labor quantity of import commodities is the weighted average of total labor quantities of export commodities.

2-2 Next we calculate total labor quantity by using international input-output tables. Here also fixed capital consumption and gross fixed capital formation are endogenous sectors.

In this calculation, total labor quantities of import commodities is the total labor quantities inputted in production of that commodities in the export countries.

2-3 The price in the calculation mentioned above is current price. We will convert the results from per a unit current price to per unit constant prices by using the deflators.

2-4 We get product quantity per a unit quantity of labor by calculating the inverses of labor quantity per a unit price of product.

2-5 We calculate TLP growth rate by using product quantity per a unit quantity of labor .

## 3. Data

We use Eora Multi-Region Input-Output Tables (MRIO) and OECD World Input-Output Tables (WIOD) through internet. (Our deepest thanks to Eora and OECD)

## 4. The novelty of this research

Through the measurements of TLP by using international input-output tables, we can not only make a comparisons of productivity growths between countries but also search the situation that Chinese productivity growths push up the productivity of Japanese and South Korean products by productivity growth of export materials from China to Japan and South Korea. Also on the contrary we can search the situation that Japanese and South Korean productivity growths push up the productivity of Chinese products by productivity growth of exports from Japan and South Korea to China and so on.

## References

- Izumi, Hiroshi and Li, Jie (2005) “Productivity Growth by industry in Japanese Economy – An estimation through Total Labor Productivity and Total Factor Productivity”, Book of Abstract 15th International Input-Output Conference Beijing
- Hiroshi Izumi and Jie Li (2005) “Total Factor Productivity and Total Labor Productivity”, Statistics, No.89, 18-34 in Japanese
- Hiroshi IZUMI and REN ,Wen(2005) “An Estimation of Productivity Growth by sector in Chinese Economy through Total Labor Productivity”, Input-Output Analysis, Vol.13, No.3, 29-39 in Japanese
- J.Li, H.Izumi and H.Yang (2008) “A Comparison Analysis of Productivity Growth in Japan and the

Republic of Korea within an Input-Output Framework" The Ritsumeikan Economic Review, Vol.LVI, No.5-6, 197-219 in Japanese
- Izumi, Hiroshi and Dai, Yanjuan (2009) "Productivity Growth by Industry in Japan, South Korea and China", Book of Abstract 17th International Input-Output Conference, Sao Paulo
Yanjuan Dai, Jie Li, Hiroshi Izumi (2013) "International Comparison of Productivity Growth in China, Japan and South Korea" Proceeding of the 2013 World Statistics Congress, Hong Kong
- Izumi, Hiroshi(2014) "A Measurement of Embodied Labor quantity and Basic Economic Indicators", Otuki Shoten, in Japanese

## The Impact of TPP on selected ASEAN Economies

Topic: 514X Special session: Economic Implications of Transpacific Partnership Agreement (TPP)
Author: Paramita DASGUPTA
Co-Authors: Kakali MUKHOPADHYAY

The Trans-Pacific Partnership (TPP) is viewed as the biggest regional trade agreement linking 12 countries on both sides of the pacific as well as the most comprehensive one in setting the regional trade rules and addressing the 21st century issues of the global economy. Its scope and significance extends far beyond the traditional trade issues, and touches some new issues like competition policy, regulatory coherence, good governance, standards of labour and environment which have hardly been a part of any of the previous trade agreements.
Since the 1990's, after the establishment of AFTA, the ASEAN became a formidable economic powerhouse and signed a number of trade pact as a group with other large economies. In case of TPP only, out of ten members of the region, four countries namely Brunei, Malaysia, Singapore and Vietnam have joined the agreement. Each of these TPP-ASEAN members has a significant trade share with the other TPP partners (ranging 34% for Vietnam and Singapore to 56% for Brunei in 2014), implying that with the greater economic integration and elimination of tariff and non tariff barriers, these countries could be the significant beneficiaries of the TPP agreement. While Crude oil and Petroleum Products are among the major export items of all four TPP-ASEAN countries to their TPP partners, the other major commodities include Electrical & Electronic goods and Chemicals for Malaysia and Singapore, and Garments for Vietnam.
Prior to TPP, the TPP-ASEAN countries have already engaged in FTAs with some of the TPP partners. Brunei, Malaysia and Singapore, being the members of AFTA, have already reduced tariffs among themselves to almost zero. Vietnam, as a latecomer in the group of ASEAN, is also in the process of meeting AFTA's tariff reduction obligations. These four countries, as the members of ASEAN, also have trade agreements with some of the large economies like Japan, Australia and New Zealand, which are also the signatories of the TPP. In fact, these four TPP-ASEAN countries, before joining the TPP, were engaged in 17 FTAs with the other eight members of TPP, suggesting that these countries had already committed to some greater integration. However, none of the TPP-ASEAN countries, except Singapore, has any trade negotiation with the US, though the country absorbs a significant share of the exports of the TPP-ASEAN nations, particularly of Vietnam. In 2014 almost 20% of Vietnam's exports were destined to the US. Also, the TPP-ASEAN countries did not have any bilateral agreements with Canada and Mexico. So, these countries are expected to be benefitted from the increased access to North American markets.
Against this backdrop, the present paper aims at evaluating the impacts of the TPP agreement on each of the four TPP-ASEAN countries by the year 2030. The analysis includes the impact of the agreement on several economic variables like GDP, export, import, labour employment, welfare etc for each of these countries. For this purpose the paper uses a global CGE framework and applies a number of simulation exercises based on the phased reduction of tariff rate on some

selected commodities between these TPP-ASEAN countries and other TPP partners. The latest version of the standard GTAP database of version 9 (base year 2011) is used to study the potential impact of TPP on ASEAN countries.
Given the overlapping of TPP and other FTAs, particularly the AFTA, the paper also makes a comparative study on the impact of TPP for the TPP-ASEAN member countries' trade with different TPP partners.
Preliminary results of the study show that Vietnam would be the biggest beneficiary of the agreement, followed by Malaysia. Both the countries mostly benefit from the reduced trade barriers and increased market access particularly in North America. Textiles and Apparel industries in Vietnam and Electronics and Chemical industries in Malaysia would be the gainers because of their preferential access to the U.S. and other major markets.

## Analyzing hotspots in environmental pressures of Swedish consumption using the Environmentally Extended Input Output database EXIOBASE 3.0

Topic: 516F Environmental IO Modelling (2)
Author: Bertram F. DE BOER
Co-Authors: Joao Rodrigues, Arnold Tukker

Environmentally Extended Multi Regional Input Output (EEMRIO) analysis offer unprecedented insight in the environmental pressure that countries exert globally. Case in point, in 2014 the Swedish EPA launched a project which employs EEMRIO analysis to assess the environmental impact worldwide of Swedish consumption. This project is called PRINCE (Policy-Relevant Indicators for National Consumption and Environment), and is performed by Statistics Sweden, SEI, Chalmers, NTNU, TNO and Leiden University (CML). The PRINCE project combines EXIOBASE 3.0, one of the most comprehensive EEMRIO databases currently available, with official national statistics. Moreover, the database is supplemented by process-based environmental extensions.

To prioritize the particular regions, sectors, and environmental pressures whose data needs to be refined, it is of paramount importance to perform a hotspot analysis of the global environmental impact of Swedish consumption. This paper contributes to the burgeoning literature on the integration of global EEMRIO analysis and individual country data by addressing the following research question: What are the global hotspots (in terms of regions, sectors, emissions and resources) associated with Swedish consumption?

The methodology will consist of a decomposition/structural path analysis of an extended version of EXIOBASE 3.0, whose list of emissions and resource use reflects the environmental pressures specified in the Swedish generational goals (http://www.miljomal.se/), including air emissions, water, fish, agriculture and metals. The dimensions yielded by this analysis will ultimately be used to assess the most significant hotspots as described above. This analysis will then be used to improve data quality and reliability for the most relevant hotspots for Sweden. Depending on project progress, results of such improvements will be included in the presentation.

The novelty of this research lies mainly in the unprecedented level of detail, and hence applicability for individual countries, in which this analysis is performed. As such, the findings of this article can be used a stepping stone towards the development of such monitoring tools for other countries, both within and outside the European Union. We further give additional insight in factors relevant for improving the reliability of global EEMRIOs.

## On the determinants of firms' surpluses and deficits

Topic: 716A  Special session: Flow of Funds Data and its Applications (2)
Author: Riccardo DE BONIS
Co-Authors: Tatiana Cesaroni, Luigi INFANTE

According to standard macroeconomic theory and national accounts manuals, households are expected to be net lenders while firms are expected to be net borrowers. However in last years, firms often acted as intermediaries rather than borrowers. For instance in the UK, Germany and the Netherlands firms have been experimenting persistent surpluses. This is quite a new phenomenon for industrial economies and there is little exploration of the underlying causes. The research question of the paper refers to the determinants of firms' surpluses and deficits. We use panel data methods and our data are the annual flow-of funds of the main industrial countries over the period 1995-2014.  Among the various interpretations we focus on the role played by capital liberalization and global saving glut in explaining firms’ surpluses and deficits.

## Integrated hybrid MRIO analysis of biofuels production in Spain: climate change and socio-economic effects

Topic: 814Y  LCA and Industrial Ecology (2)
Author: Cristina DE LA RUA
Co-Authors: Yolanda LECHON

Over the last decades, biofuel promotion in Europe has been seen as an opportunity to face the challenge of climate change. The initially domestic nature of the resources and its potential availability in Europe made biofuels to position at the top of agenda during years. However, due to the economic crises in Europe, and specifically in Spain, politicians' interest on its promotion has decreased. Concerning climate change, biofuels have usually better environmental performance than fossil fuels from a Life Cycle Thinking approach. Nevertheless, the potential socio-economic benefits that its production can provide are not usually mentioned. The objective of this study is to present the results obtained from an integrated analysis of biofuels production in Spain along the whole life cycle using an hybrid Multi-Regional Input-Output approach, taking advantage of the benefits from both Life Cycle Analysis and Input- Output Analysis.  The study has been conducted using the World Input-Output Database and specific emission factors from process LCA. The origin of the different raw materials has been also taken into account based on the latest biofuels report from the National Energy Commission. Results indicate the countries and activity sectors that benefit the most from socio-economic perspective, in terms of GDP and job creation, and those that contribute the most to climate change.

## GHG emissions' tax in Brazil using an input-output model

Topic: 714X  Special session: Taxation
Author: Kenia B. DE SOUZA
Co-Authors: Lucio Flavio da Silva Freitas, Luiz Carlos Santana Ribeiro, Geoffrey J.D. HEWINGS

The emission of greenhouse gases (GHG) generated by human activity is a major cause of global warming and climate change. There is considerable debate about the choice of the best mechanism to reduce emissions under a climate policy. In this regard, the aim of this paper is to measure the impact of a policy of taxing GHG emissions in the Brazilian economy as a whole and

in the different household groups based on income levels. To do so, we derive a price system from a national input-output model that incorporates the intensity of GHG emissions, as well as a consumption vector disaggregated in ten representative households with different income levels. The main results indicate that taxation was slightly regressive, and had a small negative impact on output. There were, however, significant emissions reductions.

## Brazilian greenhouse gas emission reductions as an optimization problem: when the government chooses policy design

Topic: 514E  Enviromental Analysis for Development (1)
Author: Kenia B. DE SOUZA
Co-Authors: Luiz Carlos Santana Ribeiro, Fernando Salgueiro Perobelli

This paper aims to evaluate the economic and environmental impacts of Brazilian greenhouse gas (GHG) emissions. The intention is simulating emissions targets in different possible scenarios for which the adopted policy design should take into account several questions, such as: What is the economic impact? Should the government intervene in all economic activities, imposing the same target? Alternatively, is it possible to reduce adverse effects by choosing specific sectors? The results highlight the importance of Livestock and Fisheries for Brazilians emissions counteracting to its economic significance. In the short term, sectoral Emissions targets could be developed in order to mitigate emissions but we suggest that in order to not overcharge the Livestock and Fisheries sector it is possible to create shared responsibilities distributing the targets for less pollutant sectors as well. However, for long term it will be indispensable the investment on technological improvements that permanently reduce pollution levels.

## Offshoring and the Functional Structure of Labour Demand in Advanced Economies

Topic: 514W  Special session: Global Production Networks: Theory and Empirics (1)
Author: Gaaitzen DE VRIES

This paper examines empirically the relation between offshoring and the onshore workforce composition in the US, Japan, and fifteen high-income European countries. Building up from detailed occupation information in labour force surveys we provide a novel characterization of the workforce classified by a generic set of functions, such as R&D, production, logistics, sales and marketing. Offshoring is measured using annual world input-output tables for the period from 1995 onwards. Estimating a system of variable demands for business functions, our results suggest that industries in advanced economies with faster growth in offshoring lower their demand for production and back-office activities, while demand for logistics, sales and marketing increases. Offshoring to advanced economies is associated with reduced onshore demand for R&D and engineering activities. The decline in demand for production activities indirectly affects R&D and engineering activities as these
are found to be complementary to production.

## What accounts for the growth in Carbon dioxide emissions in advanced and emerging economies? The role of Consumption, Technology and global supply chain trade

Topic: 711Y Special session: Analysing Environmental and Economic Consequences of Globalisation Using MRIO-SDA
Author: Gaaitzen DE VRIES

Climate policy pledges and negotiations involve commitments about the reduction of emissions within national borders. However, the rise of global value chains has changed the nature of production and international trade, blurring the attribution of ultimate responsibility for emissions. This paper applies a novel method that examines the change in territorial emissions due to changes in energy intensity, supply chain participation, and domestic and foreign consumption. Our findings suggest that rising levels of domestic consumption are related to increased carbon dioxide emissions in both advanced and emerging economies. A substantial share of emissions growth in emerging economies is accounted for by higher participation in global production networks that serve expanding foreign consumption. However, even for countries that most rapidly integrated in global production networks, such as China, rising domestic consumption accounts for the bulk of territorial emissions. Improved energy efficiency partially stemmed the spike in emissions from higher consumer demand.

## Do Exporters' and Non-exporters' Factor Inputs Differ? -- A Study Based on Employer-Employee Matched Data for Japan.

Topic: 716W Special session: APEC TiVA: SUTs with Firm Heterogeneity (2)
Author: Ivan DESEATNICOV
Co-Authors: Kyoji Fukao, Koji ITO

We use manufacturing census and wage census data for Japan to construct extended Input-Output table for 2011 that accounts for heterogeneity in exporting activities. We split each manufacturing industry in the block of OECD Inter-Country Input-Output (ICIO) table related to Japan into exporting and non-exporting sector. Then we optimize the ICIO table using quadratic programming optimization techniques. First, this enables us to compute various indicators such as domestic value added (DVA) in exports, foreign value added in exports, domestic value added embodied in foreign final demand. The preliminary results show that DVA is generally lower for most of industries if we account for firms' heterogeneity in exporting activities. We infer that exporters rely more on foreign intermediate inputs and outsourcing activities. Second, using employer-employee matched data we compute and analyze employment created by foreign final demand for exporting and non-exporting sectors. Our findings suggest that accounting for heterogeneity by exporting activity can provide a better understanding of various firms' factor inputs' contribution to the domestic value added and employment creation.

JEL Classification Number: F12, F14, C61, C67, C81
Key words: Firms heterogeneity, Input-Output Tables, Export Intensity, Factor Inputs

## Hypothetical extractions from a global perspective

Topic: 809W  Methodological Aspects of MRIO Analysis
Author: Erik DIETZENBACHER
Co-Authors: Bob van Burken

The hypothetical extraction method (HEM) has been widely used to measure interindustry linkages and the importance of industries. HEM considers the hypothetical situation in which a certain industry is no longer operational. Using the input-output framework, it then calculates the outputs in the entire economy that are necessary for the original final demands. The difference between the original outputs and the reduced outputs in the hypothetical situation are a measure of the linkages of the deleted industry. HEM was developed for national economies, using national input-output tables. When performing HEM it is important that other things remain the same in order to single out the actual effect of the extraction. At the national level this means that the remaining industries still receive the inputs they require. It is therefore assumed (often implicitly) that the input requirements that were originally provided by the extracted industry are met by additional imports in the post-extraction situation. Applying HEM to global multiregional input-output tables, however, causes serious problems. The assumption to import the required inputs (that were originally provided by the – now – extracted industry) from outside “the system”, is no longer possible. It would assume importing from Mars. All this implies that the standard HEM, as developed for a national context, cannot be transferred straightforwardly to a global context and needs to be adapted. In this paper, we provide such an adaptation, the global extraction method (GEM).

## Using the Input-Output Model for Evaluating the Impact of Environmental Restrictions on the Economic Development of the Republic of Buryatia, Russia

Topic: 514E  Enviromental Analysis for Development (1)
Author: Zorikto B. DONDOKOV
Co-Authors: Konstantin Pavlovich Dyrkheev

Lake Baikal is a unique natural site listed on the UNESCO World Heritage List. There is a special regime for natural resources management throughout the Baikal Natural Territory (BNT), which covers Lake Baikal and the surrounding specially protected areas. The activity of timber and wood processing companies, agricultural enterprises, and fisheries is prohibited or strictly limited in this area. It negatively affects social and economic development of the BNT, which covers over 72% of the territory of the Republic of Buryatia, Russia.
The study presents calculations of direct and indirect economic losses of the region due to declining production and lost earnings in related sectors. These calculations are made based on the Input-Output Table of the Republic of Buryatia for 2011, which includes 50 types of economic activity.
The paper proposes an input-output model for analyzing social and economic development of the region using strict environmental restrictions as exogenous variables. The authors evaluate multiplier effects of the increment of gross output, tax revenues, and employment. They also make scenario calculations of direct and indirect economic losses of the Republic of Buryatia stipulated by the impact of restrictions on economic activity in the Baikal Natural Territory.

* This research is funded by the Russian Foundation of Fundamental Research under Research Project No. 15-46-04321: “The study of the impact of the “Baikal Factor” on the social and economic development of the Republic of Buryatia based on the input-output model with an expanded composition of endogenous parameters”.

## New Approach to Household Disaggregation in the System of National Accounts-2008 and Its Application in Input-Output Models

Topic: 516Z  IO Accounts and Statistics (1)
Author: Zorikto B. DONDOKOV

The author develops an “Input-Output Model of Aggregated Expenditures” (IOMAE), in which household consumption is included into the composition of endogenous parameters. This model is based on a hypothesis of homogeneity of intermediate consumption and consumer expenditures, which determines the possibility for summing them for modeling.
According to the proposed approach, household income and expenditures are considered across sectors. Each household is viewed as a separate economic unit receiving income in certain sectors and using it for purchasing products of various other sectors.
Households are grouped into sectors based on the sources of their income. The column-vector of household consumption is replaced with an “Input-Output Matrix of Household Consumption”, the structure of which is analogous to the 1st quadrant of the input-output table.
The author develops a method for creating an Income-Expenditures Matrix (IEM), which includes the Input-Output Matrix of Household Consumption, welfare payments, property income, costs to cover mandatory payments, savings accrual, and other monetary inflows and expenditures.
The method for creating the IEM is explained stage by stage. The author describes key questions in the survey questionnaire, which was used to collect data on household income and expenditures. A distinctive feature of this questionnaire is that income and expenditures are distributed in accordance with the All-Russian National Classification of Economic Activities. The author explains the process of developing the IEM and calculating relevant coefficients.
Finally, the paper presents the results of experimental calculations of the IEM based on the study conducted in the Republic of Buryatia, Russia.

* This research is funded by the Russian Foundation of Fundamental Research under Research Project No. 15-46-04321: “The study of the impact of the “Baikal Factor” on the social and economic development of the Republic of Buryatia based on the input-output model with an expanded composition of endogenous parameters”.

## Dynamics of China’s pollution terms of trade and their determinants

Topic: 814F  Trade and Environment
Author: Yuwan DUAN
Co-Authors: Xuemei Jiang

This paper has investigated the dynamics of China’s environmental outcomes relative to its economic gains from international trade from 1995 to 2009 by using the World Input-Output Database. The results suggest that China suffers from more emission to obtain per unit of value

added through its exports than do its trade partners. However, the gap declined quickly from 1995 to 2001, but since then has slightly increased. The driving forces behind the dynamics of China's pollution terms of trade (PTT) are further explored by using structural decomposition analysis. The decomposition results show that the technology effect is the main driving force behind these dynamics, while the global trade pattern has played an increasing role in the dynamics of PTT especially after 2001, with opposite effects on China's PTT in trade with different income groups.

## Exploring the Relations between Input-Output Models and Computable General Equilibrium Models

Topic: 516C Special session: Exploring the Interface between IOA and CGE
Author: Faye DUCHIN

The square matrices A and (I - A)-1 are calculated historically from a flow table in money values for a past year. This origin assures that x = (I - A)-1 y, the equality that comprises the basic input-output model. The accounting database describes the past, and the basic model is able to reveal underlying linkages in that economy. New values for x or p can be calculated for assumed changes in y or v, but the model provides no basis for making these assumptions. Analyzing scenarios about the future requires shifting the framework from description to explanation of key relationships among consumption, production, and exchange activities.

My research has involved formulation of the World Trade Model and the Rectangular Choice-of-Technology Model (with S. Levine), both formulated as constrained optimization models reflecting the theory of comparative advantage. Both offer choices among alternative technologies subject to physical constraints on production. Demand impacts prices of both factors and goods, while (the exogenous portion of) factor prices impact production choices among technologies and among geographic regions. Our dynamic input-output model (with D. Szyld) imposes inter-temporal inter-sectoral consistency and assures that the profits of a sector, plus any borrowing from other income streams, cover money outlays for built capital. These models extend the explanatory power of the basic model. Global CGE models, with their foundation in neoclassical economic theory, are also suited for analysis of scenarios about the future but on the basis of substantially different assumptions.

Even when there is general agreement on theory (as there is for comparative advantage), there is no unique way to reflect it in a formal model, which depends on the choice of key variables and the functional forms for the equations that relate them to each other. This presentation focuses on a few of the fundamental ways in which the conceptual basis for contemporary input-output models differs from that of CGE models and discusses the rationale for the input-output approach:

-Model transparency
-Objective: Minimizing resource use or environmental degradation, or maximizing consumption or growth
-Mechanism of price formation: relation between changes in resource adequacy and changes in prices of goods
-Functional forms: logical relationships or computational tractability
-Parameters: vectors of inputs per unit of output or elasticities of substitution
-Technological options: choice among alternative technologies, or (nested) substitutions among individual factors of production

-Resource endowments: Impacts on prices of full vs. partial utilization
-Dynamics of investment in built capital and of stocks of non-renewable resources: inter-sectoral as well as inter-temporal consistency
-Ways to (and not to) make consumption endogenous.

## Productivity Growth of Resource Accumulation in the Cities of Japan

Topic: 714D  Productivity and Efficiency (2)
Author: Shogo EGUCHI
Co-Authors: Shigemi Kagawa

In society, accumulated social infrastructure such as buildings, roads, and railways are the basis for human life and productive activities (Fischer-Kowalski, 1998). The accumulated resources associated with buildings and infrastructure construction (the stocks of accumulated iron products, concrete, timber, etc.), however, differ substantially over cities (Tanikawa et al., 2015). In Japan, particularly since World War II, vast quantities of roadways and urban structures have been built, resulting in a massive accumulation of resources in cities (Tanikawa et al., 2015). It is unclear, though, how efficiently this accumulated investment of resources has been utilized. The present study employs a Data Envelopment Analysis (DEA) framework using a long-term panel data of the physical stocks of buildings and infrastructure (roadways and railways), labor force and gross output of Japanese 46 cities during the period of 1970 to 2010. This study analyzes the change in the efficiency of production resulting from the labor force and stock accumulation in Japan’s cities for the study period in order to evaluate how this efficiency has changed over the years. In addition, by identifying cities where production efficiency has increased or decreased, the study explores possible ways of improving production efficiency in relation to the stock of resources in Japan. The results show that productivity change in each city, between 1970 and 1990, productivity increased in almost all of Japan’s cities. One factor behind this was that the technical change—or in other words, the development of an efficient production frontier—gave rise to substantial productivity growth. On the other hand, between 1990 and 2010, productivity declined in approximately 80% of Japan’s cities including big cities such as Tokyo, Osaka and so forth. One reason for this was that catch-up to the efficient production frontier failed to occur in any of these cities, while the frontier itself also retreated. It is clear from these results, therefore, that the productivity in most of Japanese cities peaked in 1990 and declined after 1990 steadily.

## Measuring Supply-Side Inefficiency Spillovers in Global Value Chains

Topic: 809B  Innovation and Technological Transfer
Author: Hubert ESCAITH
Co-Authors: Sebastien Miroudot

Research question / Preliminary and Tentative Outline

The paper explores  new ways of looking at the supply side growth models when Global Value Chains (GVCs), with an emphasis on the differences that the global value chain perspective brings when looking at GVC-specific export-led growth strategies (joining GVC then up-grading by incorporating more domestic value-added). The paper uses the TiVA data to offer new perspectives for analysing the international competitiveness of domestic industries. Applying

benchmarking techniques to international input-output data offers a way of identifying industrial inefficiencies.

- Sectoral efficiency: basic indicators

There are many definitions of productivity and efficiency. The most intuitive is approximated by the sectoral Value-Added per unit of Output. Comparing sectoral ratio with other foreign producers, nevertheless, does not reflect only differences in gross return per unit due to technology as reflected by the (IO matrix) technical coefficients, but also the difference in the purchase price of inputs and output. Even under the assumption of a unique international price for tradable goods, domestic prices are affected by trade costs, while the price of non-tradable inputs (services and primary inputs) is affected –inter alia– by the Balassa-Samuelson effect (Feenstra, Inklaar and Timmer, 2015).

These adjustments are expected to affect the basic efficiency indicator, especially in developing countries, which usually have a more protectionist policy and benefit from lower costs of living than –for example-- the US. The size of the gap provides some indication of the productive shift that the sector would require to maintain its profitability if domestic prices were to align on international ones.

- Benchmarking inefficiencies

The paper intends to apply frontier analysis using a series of alternative option.

The first one is data envelopment analysis (DEA), which has been used extensively in the last 30 years in the estimation of production frontiers for private and public entities. DEA has evolved considerably since its early days of Operational Research and now allows to include stochastic and random effects, allowing more flexibility. An advanced DEA analysis is also expected to deliver additional information on how the actual performance of sub-optimal industries could be improved, by comparing them to their peers located at the frontier. Such an analysis would, nevertheless, differ from standard DEA and consider that those industries are located in different countries, facing different external constraints. Assessing the performance of industries in a collection of different countries would require separating sub-frontiers (or meta-frontiers), something which falls outside the objectives of the present essay.

The DEA results (resulting from a non-parametric approach) will be compared with alternative parametric methods. The parametric methods require the ex-ante specification of a production model, whose parameters are subsequently estimated using econometric methods (usually based on Maximum Likelihood Estimators

Combining parametric and non-parametric approaches will lead to a clearer identification of the institutional variables that affect efficiency. As some (most) of these variables are the object of economic policy (trade policy; structural reforms; ease of doing business), the results should help identifying, (i) within the groups of countries constituting the various meta-frontiers, what are the key variables that require attention to reduce efficiency compared to direct peers, and (ii) across groups of countries, what are the priorities for a policy aiming at closing the efficiency gap with best performers, a necessary condition for up-grading the mode of insertion in global value chains.

Data used: OECD-WTO Trade in Value Added (TiVA) and underlying International Input-Output Tables

Novelty of the research:

Most research on efficiency frontiers involves firms that share similar (national) envirnonments. Applying non-parametric/parametric/stochastic benchmarking analysis to industries facing different institutional and pricing environment raises a series of issues which will be identified, analysed and -hopefully- solved by the paper.

This will be a contribution to an important policy issue in a trade in value-added analytical framework: what is the relationship between comparative advantages (a macro perspective) and competitiveness (a micro perspective).

## Can the Value-Added-Rate Reflect the Quality of Economic Growth?

Topic: 711D  Productivity and Efficiency (1)
Author: Jin FAN

It has been listed as one of the key indicators of the quality of the industrial sector and manufacturing sector in “Industrial transformation and upgrading plan (2011-2015)” and “Made in China 2025 Plan” respectively, for the industrial and manufacturing value added rate (Hereinafter referred to as the VAR). However, some facts are otherwise. For example, in the province of China, the increase in the industrial VAR level is almost the opposite of the economic development. The main conclusions have been drawn as follows: Firstly, there exists a threshold level of VAR. When the real VAR is below it, the larger the real VAR, the higher the quality of economic growth is. However, once the real VAR is above the threshold level, the trend shows the opposite trend. Therefore, we should be caution in practice, otherwise may backfire. Secondly, there exists a long-term co-integration relationship between the real VAR and the threshold level value, and there also exists an inverted U relationship between the real VAR and Total Factor Productivity. Finally, the threshold level of VAR varies considerably in different countries, and it is associated with the capital depreciation rate, population growth rate, saving rate and other macroeconomic indicators. Therefore, we need to fully implement “The Recommendations of the Thirteenth-Five-Year Plan of the Communist Party of China Central Committee on National Economic and Social Development” spirit, to enhance China’s VAR threshold level as to achieve consistency between the real VAR and quality of economic growth.

## Measuring and comparing the international carbon trade efficiency of major countries

Topic: 814F  Trade and Environment
Author: Jingli FAN

With the globalization of the world economy, the multiple parts in the production process of a commodity are gradually divided into different countries, and a large number of intermediate products are flowing among different countries. Accordingly, what the distribution of the value added of specific commodities from the global value chain perspective has gained widely attention. Meanwhile, many studies has focused on computing the embodied greenhouse gas (GHG) emissions of international trade. While little literature pays attention to the measurement of carbon trade efficiency which makes a linkage between embodied CO2 emission and supply value chain. By using extended multi-countries input-output models based on world input-output

database (WIOD), this paper constructs a macro carbon trade intensity index to measure the carbon efficiency of international trade which plays a significant role in helping each country to understand their emission responsibilities more profoundly. Based on the global value chain and embodied carbon emissions, this index can be understood as the negative externalities of the country, which is a measure that can include the economic benefits. Meanwhile, the higher the carbon trade intensity, including the export carbon intensity (ECI) and import carbon intensity (ICI), the stronger the negative externality. Note that the domestic carbon intensity (DCI) index means the negative externality of the domestic consumption to their own country, which can be compared with the ECI and ICI. Combining the value added extended GMRIO model and the environmentally extended GMRIO model and by using world input-output database (WIOD), this paper calculated and compared the carbon trade intensity of 14 major countries based on which some policy implications are discussed. The main findings are as following: 1) The intensity indices for China, India, Chinese Taiwan and Russia reveal the characteristic of ECI > DCI > ICI, while for other countries, the characteristic is ICI > ECI > DCI; Meanwhile, there is not much difference in the ICI between countries, while obvious differences exist between their ECI; Moreover, the ECI of the developing countries (including the transition countries) are significantly higher than those of the developed countries. 2) Compared with 1995, almost all countries' three types of carbon intensities decreased, although with different decline degrees; The carbon trade intensities of developed economies are concentrated and do not decline much, while the ECI and DCI of China, India and Russia are all very high and decrease significantly, with China's ECI decreasing most by 42.5%; In particular, the increase in the ECI would bring more challenges to Taiwan's energy-saving and emission reduction.3) Seen from the bilateral carbon trade intensity (in 2009), there is no big difference in the ECIs of China to other countries; for India, bigger differences exist in its ECIs to other countries; the ECIs of Russia to other countries are commonly high; and the most surprising result is that the ECI of Taiwan to Japan is the highest and much higher than those to other countries; In addition, the ICIs of Australia, India, Japan and the US with oversea countries all show that those oversea trading countries with a higher intensity are mainly concentrated in several developing countries and transition countries.

Keywords: Carbon trade efficiency; Developed and developing countries; Import carbon intensity; Export carbon intensity; Climate change

## Good at goods, bad at services? The interaction between trade in goods and trade in services of China

Topic: 809Z  International Trade (1)
Author: Yang FAN
Co-Authors: Lianling YANG

China is the one of the biggest trade entity in the world. From the perspective of trade volume, trade in goods accounts for more than 90% of China's total volume, while trade in services accounts less than 10%, far below the international average of 20%. The export volume of service trade reflects the competitiveness of China's service industry in foreign trade, which shows that China's service industry is still undeveloped yet. We use non-competitive time series input output table and find that the contribution of service industry in foreign trade has been underestimated given the expression that only the proportion of exports is to be measured. First of all, the proportion of service trade has increased significantly in the by the value added accounting. In 2012 the proportion of service trade accounts for 8.5% of the total exports, and this number increases to 11.3% in the form of value added. Second, from the perspective of the relevance of the industry production, of all the domestic value added stimulated by the exports of goods,

service sector contributes more than 30%. Therefore, the importance of trade in services is amplified by the large volume of China's goods export.

## A New Subnational MRIO Table for Indonesia

Topic: 814W  Special session: Input-Output Virtual Laboratories (2)
Author: Futu FATURAY

Indonesia is an archipelago country with 5 main islands, and more than 14,000 small islands. Given its geographical size and economic diversity, the comprehensive information capturing all Indonesian area is vital. However, this vital information appears not to be sufficiently integrated and harmonised. It, therefore, might prevent the establishment of the economic and environmental modelling for investigation of the national and sub-national issues, such as impact of inter-regional trade, return on investment of social spending among regions, and individual income disparity and regional tax potential. The sub-national work using the input-output concept is applied to the Australian Industrial Ecology Laboratory (IELab) which integrates all possible economic and environmental data into a single system at high regional and sectoral detail. Following the construction process of the Australian IELab, we will introduce a novel concept to Indonesian research environment: a collaborative work of input-output modelling on a cloud-computing environment. The Indonesian IELab is proposed to be the most comprehensive input-output table in Indonesia, capturing 1,148 economic sectors and 495 cities and regencies. The concept of this virtual machine is that it gives flexibility for multi-discipline users to construct their own MRIO table in order to suit their own research purposes. The 2010 national input-output tables consisting of 185 sectors are utilized as the main data and the 2010 labour survey (Sakernas) consisting of 1,148 sectors and 495 cities and regencies are utilized as the proxy for regionalisasion.

## The Generalized Dynamic Input-Output Principle

Topic: 711B  Methodological Aspects of IO Analysis (1)
Author: GUANGMING FENG

My paper, entitled as "The Generalized Dynamic Input-Output Principle ", has been advancing the Nonlinear Model of the Generalized Dynamic Input-Output System (NMGDIOS) and solving its optimal solution of Pontryagin maximum. The Generalized Dynamic Input-Output System (GDIOS), on the theoretical plane, which is going to be the result from the synthesis of the optimal control theory, the general reproduction, the productivity theory and the input-output analysis.
Facing a few of input-output tables, like the count of distinct digital map recorded around the world in a year or a certain period of the national economy. But, the input-output table of different years, however, can only indicate an isolated, static state at one time point of national economic situation, does not reveal which exists the inner and inevitable connection among different input-output tables.

In the current input and output system, time "t" is usually defined by the nature time. Such as the continuous dynamic input-output model by W.Leontief, But, as so long as limiting the dynamic input-output analysis on the basis of the nature time series, is to meet the inconsistency problem between the theoretical prediction and the actual event on the time step size or the time point etc., which does not have the inevitable reproducibility characteristics necessary to predict the future events.

The Production Function Structure Classification(PFSC) in my paper, as the result from my research for the evolution of labor instruments in human history, is the comparison study among laborers, his tools and its functions in historical evolution, abstracts have common characteristics and generalization. Therefore, carried out classifying sectors in accordance with the PFSC, to span of time step beyond nature and to get rid of the fixed time step and its sequence, thus makes the input-output analysis based on the qualitative change of productive forces in history, and is closely related to laborers, his tools and its functions, that come into being common rhythm or developed on the basis. So I use the PFSC to classify different structures for the input-output system and to approach the evolution of the varied typical input-output systems from lower type to higher one in accordance with different typical productive forces.

The GDIOS can be regard as making the choice in the varied time point, which connects with every type or each stage of productive forces and with the process of social reproductions, based upon the dynamic structure and balance conditions of the varied productive forces, so that the GDIOS has a few of characteristics, due to the PFSC, such as speeding up the economy development, shortening the production cycle and raising productivity etc.

In my paper, I try using the principle of Pontryagin maximum, by constructing the Hamiltonian, forming and solving the corresponding Jacobian matrix, calculating with in-homogeneous differential equations solution and general solution form, thus constitute the Pontryagin maximum solution for the Generalized Nonlinear Dynamic Input-output Model and deduce the coexistence of diverse types.

## A Generalized Cross Entropy formulation for matrix balancing with both positive and negative entries

Topic: 516Z  IO Accounts and Statistics (1)
Author: Esteban FERNANDEZ-VAZQUEZ

This paper presents a matrix balancing technique based on Generalized Cross Entropy (GCE) that can be suitable for matrices containing both positive and negative entries. This technique makes possible sing flips in the cells of the initial and the estimated matrices, which can be something desirable in situations where assuming sign-prevention for all the entries of the matrix could be too restrictive. An additional advantage is that GCE allows for doing some inference with the estimates, something not possible when using biproportional balancing techniques like Generalized RAS (GRAS), which is the method commonly applied to balance matrices with positive and negative cells. The basic idea of the proposed GCE method is to assume each cell of the target matrix as a random variable for which we have partial information in the initial matrix. The GCE procedure assumes each observation in this matrix as a specific realization of a random process that generates the cells and it requires setting exogenously some bounds for the maximum and minimum values that this random process could generate. From this information, together with some partial data on the target matrix, the adjustment process is approached as a -constrained- minimization problem of a Kullback-Leibler divergence. A simple illustrative example shows how GCE works when adjusting a matrix characterized by having positive and negative entries within a Supply and Use (SUT) framework. Additionally, its performance is evaluated by means of a numerical simulation.

## Greenhouse gas emissions by agriculture in the Brazilian amazon

Topic: 516E  Enviromental Analysis for Development (2)
Author: Gisalda C. FILGUEIRAS
Co-Authors: Denise IMORI, Joaquim J.M. GUILHOTO, Carlos R Azzoni

The Legal Amazon region includes the Amazon biome, the Pantanal (swamp) and the Cerrado (savannah). Starting in the early 1970s, agriculture, livestock, forestry and mining developed at fast speed in the region. In 2009, these activities accounted for 13.5% of GDP. Livestock alone produces, per cattle head, an average of 80-100 kg of methane per year. Deforestation has been a major cause of carbon dioxide emissions. The National Institute for Space Research (INPE) recorded and yearly average emission of around 850 million tons of CO2 resulting from deforestation between 1988 and 2008. The objective of this paper is to estimate the GHG emissions generated by cattle ranching and deforestation in the Amazon region. This is done by applying a 2 Regions, Amazon and Rest of Brazil, input-output (I-O) model built specifically for these regions by using the database of the Regional and Urban Economics Laboratory of the University of São Paulo (NERUS) of Municipal I-O tables for the year 2009. The paper makes an estimation of the GHG emissions produced by primary activities, their link with deflorations and the responsibility of the consumer at the internal and external markets. The paper also presents a discussion of the effective role of government policies aimed to emissions reduction.

Keywords: Brazilian Amazon; GHG; Deforestation; IOM

## Refining the Application of the FLQ Formula for Estimating Regional Input Coefficients: An Empirical Study for South Korean Regions

Topic: 809A  Regional IO Modelling (1)
Author: Anthony T. FLEGG
Co-Authors: Timo TOHMO

This paper uses survey-based data for 16 South Korean regions to refine the application of the FLQ formula for estimating regional input coefficients.  Especial attention is paid to the choice of a value for the unknown parameter δ in this formula.  Along with regional size, this value determines the size of the adjustment for regional imports in the FLQ formula.  Earlier research on this topic using data for two South Korean regions was done by Zhao and Choi (2015).  However, using the same basic data, we were unable to replicate their findings.  We also identify several methodological shortcomings and some non-trivial computational errors in this pioneering study.  We demonstrate that Zhao and Choi have overstated the optimal values of δ for these two regions and understated the FLQ's accuracy.  We also establish that the regression model of Kowalewski (2015) is wrongly applied in computing sector-specific values of δ for these two regions.  Furthermore, we show that Zhao and Choi's re-estimation of the regression model of Flegg and Tohmo (2013a) yields erroneous results.  As well as reworking Zhao and Choi's analysis and extending it from 2 to 16 regions, we make several refinements to Flegg and Tohmo's original model, which was based on data for 20 Finnish regions.  Our paper adds to the work of Flegg and Tohmo (2013a, 2016) and Flegg et al. (2016), the underlying aim of which is to find a cost-effective way of adapting national coefficients, so as to produce a satisfactory initial set of regional input coefficients.

## Cross-Hauling and Regional Input-Output Tables: Can CHARM Make Adequate Adjustments for Cross-Hauling?

Topic: 811A  Regional IO Modelling (2)
Author: Anthony T. FLEGG
Co-Authors: Yongming HUANG, Timo TOHMO

This paper reviews the available empirical evidence on the performance of Kronenberg's CHARM (Cross-Hauling Adjusted Regionalization Method), a relatively new non-survey technique that takes explicit account of cross-hauling when constructing regional input-output tables. Our focus is on the evidence presented in Flegg and Tohmo (2013) and in Flegg et al. (2015). These papers employ survey-based data for two contrasting regions: Uusimaa, the largest Finnish province, and the central Chinese province of Hubei. In the case of Uusimaa, detailed data for 26 regional sectors in 2002 are examined. CHARM is found to perform relatively well in terms of its ability to generate adequate estimates of exports, imports, the volume and balance of trade, and supply multipliers. For instance, on average across the 26 sectors, the unweighted mean supply multiplier from CHARM is 1.542, which is not far above the target figure of 1.482. The results are particularly encouraging for manufacturing sectors, which typically produce heterogeneous commodities and where cross-hauling is rife. As regards Hubei, CHARM is used to construct a detailed regional input-output table with 42 sectors, including 17 different types of manufacturing. The analysis makes use of official published national and regional data for 2007. However, in this instance, CHARM does not generate reliable estimates of Hubei's sectoral exports, imports, volume of trade, and supply multipliers. This outcome is attributed to the difficulty of getting satisfactory estimates of regional technology, heterogeneity and final demand for this data set. This problem is, in turn, linked to the relatively small size of Hubei, which generates around 4% of China's GDP. By contrast, Uusimaa produced 34.6% of Finland's national output in 2002. These findings highlight the crucial importance, especially in relatively small regions, of adjusting for any known divergence between regional and national technology, heterogeneity and final demand. Various strategies are explored for implementing such adjustments. The paper also discusses the work of Toebben and Kronenberg (2015), who demonstrate how CHARM can be adapted for use in a multiregional context.

## Constructing a time-series of physical input-output tables for Australia using RAS

Topic: 714E  Special session: Economic and Environmental Relationship in Asian-Pacific (1)
Author: Jacob FRY
Co-Authors: Timothy M Baynes, Manfred LENZEN, James West

A large proportion of physical material flows in the Australian economy involve the construction industry. However unfortunately, there is currently no complete account of these physical flows for Australia. This hinders environmental impact analysis and makes assessing progress towards the `circular economy' difficult. If the magnitude and composition of these material flows was known, future resource requirements for building stock growth could be predicted. In addition, the availability of waste products from the dismantling of building stocks for use as inputs to new structures could be estimated. The capability of existing domestic recycling infrastructure to recover these wastes, as well as the existence of markets for recycled products, could also be assessed. Producing an account that maps these physical flows can be difficult since generally physical data describing the economy is less detailed than monetary data. In addition, physical production data is both limited in the number of products covered and to economy-wide totals,

and industry-level consumption information typically does not exist. In this study, we construct a time-series of physical input-output tables (PIOTs) for Australia that contain high-detail for the construction industries from 1985 to 2012. A RAS procedure is implemented to leverage all available physical data and to impose conservation of mass on the system. A variety of constraint types are used, including point, summation, ratio and balancing constraints. These are the first physical IO tables to be constructed for Austalia to the authors' knowledge and have a resolution of 130 products/industries. The usefulness of these tables is demonstrated by the tracing of waste products back into new production.

## Reducing Carbon Emissions Via Structure Change Along A Consumption Turnpike: A Remesey-Tsukui-Leontief Dynamic Environment System Of China

Topic: 516E Enviromental Analysis for Development (2)
Author: Xue FU

Replacing applicable capital turnpike model (Tsukui and Mutakami, 1979) completely resolved by linear programming, an environmental oriented consumption turnpike is firstly presented, with maximum residents' real welfare represented by accumulated long-term utilities (Remesey, 1928), however, it irresolvable before the development of a new dynamic programming model. Along this effective sustainable growth path, structure changes might enable China to meet its 2020 goal for carbon emissions reduction, where an environmental oriented dynamic input-output system of China is formatted in a dynamic programming and at given national carbon targets, with the aim of maximizing national utilities (or consumptions) over accumulation period, under constrains for both demand-supply dynamic balance and the magnitude of output and energy-use change within realizable and practical limits. The novels of Remesey-Tsukui-Leontief turnpike model are integrating the dynamic input-output model with a new dynamic programming with both constraints under given terminal condition and national carbon targets, and an objective maximizing the accumulated final demand (excluding investment) over the planning time, rather than that maximizing the terminal capital in Tsukui' capital turnpike. By a new reverse algorithm, a solution to an effective sustainable growth path finds inter-industry shifts of production and investment enable China, with reasonable ratio of consumption to investment accumulation on the long term, to reduce carbon emissions per GDP by at least 40% of its 2005 levels before the year 2020. The model suggest that increasing service share by 5% without panel manufacture growth, increasing consumption annually by ten point percentage than actual economy performance would help China's economy growth more effectively.

## Net emission transfer of toxic chemical substances: Empirical study for U.S. manufacturing industries

Topic: 814Y LCA and Industrial Ecology (2)
Author: Hidemichi FUJII
Co-Authors: Shunsuke OKAMOTO, Shigemi Kagawa, Sangwon SUH, Shunsuke MANAGI

The U.S. toxic release inventory (TRI) database has been prepared as an information to properly manage toxic chemicals since 1986. In Europe, a strict environmental regulation for toxic chemicals emission, -Restriction of Hazardous Substances Directive- has been started as since 2006 and the manufacturing sectors which export to Europe has been obligated to produce their products that do not contain toxic chemicals exceeding the environmental regulations. Thus the

manufacturing sectors have tried to reduce the toxic chemicals technologically in the U.S., especially manufacturing firm exporting to European country.

Previous studies focused on how the strict chemicals regulation has affected productions of manufacturing sectors in the exporting countries (Fujii et al., 2011). The above studies are important in evaluating the role of the environmental regulation on trade and toxic chemicals emission, however it should be noted that the toxic chemicals emission is a result generated through the product supply-chains connecting consumers to producers and the emission sources are also wide. This study focuses on the U.S. toxic chemicals emission during 1998 to 2010. Our research question is how the toxic chemical emission has been affected by the changes in (1) scale of final demand, (2) production technologies in U.S. manufacturing sector, and (3) structure change of international trade patterns.

To clarify this question, we apply following two methods. Firstly, we estimated the U.S. toxic chemical substances emission and emission transfer from other countries to the U.S. by using environmentally-extended multi-regional input-output analysis model (Kagawa et al., 2015). Second method is log mean Divisia index (LMDI) approach to clarify the determinants factor of production technology change in U.S. manufacturing sectors (Fujii and Managi, 2013). We propose new decomposition research framework of production technology change using LMDI focusing on the four factors which are (1) cleaner production, (2) end of pipe, (3) transfer for offsite management, and (4) toxicity of emitted chemical substances.

This is the first study focusing on the induced effect of toxicity by chemical substances emission in production process. The induced effects of toxicity represent how manufacturing process is clean and low toxicity. Therefore, we can understand the effect of international chemical regulation into U.S. manufacturing process by change of induced toxicity. Additionally, we believe the research framework focusing both demand and supply side using multiple factor decomposition is unique. Therefore, the concept of induced toxicity effect and developed research framework are the novelty points of this study.

Toxic chemical emission data in U.S. manufacturing sector is observed from the TRI database published by U.S. EPA. We use about 600 chemical substances emission and each toxic chemical substances has different toxicity. To integrate their toxicity, we apply the risk-screening environmental indicators published by U.S. EPA. Additionally, international trade data is observed from world input output database (Timmer et al., 2015).

The major results are summarized as follows. Mining industry and paper and pulp industry increased induced toxicity due to production scale expansion. Surprisingly, wood, electric product, and transportation equipment industries had decreased induced toxicity more than 90% from 1998 to 2011. The main determinants factor of this rapid decline is decreasing of toxicity per production. From the production technology decomposition results, this factor decreased due to toxicity per emission amount, which imply three industries successfully reduced their induced toxicity by substitution of chemical substances. Additional, we found the China, India, and Brazil increased induced toxicity from 1998 to 2011. Meanwhile, many European countries decreased their induced toxicity. Further discussion related with international chemical regulation will be available at the conference.

## An empirical study on the trade network between Korea and Japan

Topic: 714A  Special session: Competitive and Complementary Economic Relationships between Korea and Japan
Author: Kiyoshi FUJIKAWA
Co-Authors: Bawoo Kim

Trade patterns are determined based on the conditions in resource endowment according to the Heckscher-Ohlin's classic trading theory. The trades in the reality, however, do not follow the theory, which is known as a Leontief paradox.

Let's take trades between Japan and South Korea as an example. Japan keeps trade surplus in the trade with South Korea even though the economy of South Korea is matured and the industrial structure has upgraded. Some researchers point out that the one of the reason is South Kore's imitation in the industrial structure from Japanese economy. In a word, there is a structure that the import of Intermediate goods from Japan increases when South Korea tries to increase export because South Korea's industrial structure is similar to Japan's. Recently, the export of South Korea to the world increases while Japan's trade surplus in the trade with South Korea decreased greatly.  This tendency shows that the trade structure between the two countries has changed.

This research tries to observe the current trend of the change in the industrial structure in Korean and Japanese economies or trade structure between Japan and Korea and find some clues on the reason of these structural changes

## Economic effects of Japanese pickles industry

Topic: 814C  Special session:Economic Impacts of Specific Foods: Kimchi, Tsukemono, Tomato
Author: Kiyoshi FUJIKAWA
Co-Authors: Mariko Makita

Recently, Asian food draws international attention.  As to Japanese food, it is such high-level food or drink as sushi or refined sake that are well known in the world and they are not what ordinary people eat in a daily life. The economic impact of those food, therefore are limited. Then, this paper sets a focus on pickles of vegetable or Tsukemono in Japanese that all Japanese eat almost every day while this paper introduces relative position of pickles in Japanese economy and estimates its economic effects.

Incidentally, Japan is famous for input output table with detailed industry classification. The recent I-O table is for the year 2011 whose size of the part of intermediates transactions is 520 rows by 407 columns. Tsukemono industry is included in the industry of preservation food of farming production (except jar and canned food) with code 111602. However, it is necessary to note that dehydrated vegetables and dried fruits besides pickles are also included in this industry classification.

In this report, first of all, we overview the pickles industry by looking into the consumption basket of Japanese households or calculating the import dependency in the supply of pickles in Japan and introduce pickles industry using measures of traditional input-output analysis such as backward and forward linkage, output ripple effects and final demand dependency. In addition, we estimate economic effects of demand increase in the pickles industry through increase in food exports and increase in foreign tourist to Japan.

# Exploratory analysis of the use of a multi-regional Input-Output Matrix for the analysis of the main urban impacts of the new Mexico City International Airport.

Topic: 814A  Regional IO Modelling (3)
Author: Karina GARDUÑO
Co-Authors: José M. SANCHEZ, Normand Asuad Sanen

The new Mexico City International Airport (NMCIA) will have different economic and social impacts generated in the stages of both construction and operation. It is expected that this new airport will not only be an important node in terms of economic benefits, but also in terms of the urban impacts it will generate within the urban area of Mexico City, highlighting among others, housing, transport infrastructure and road works.

Thus, the question that guides this research is: What will be the main urban impacts generated by the new Mexico City International Airport, in housing and transport infrastructure within the city? Hence, it pretends to understand and analyze the urban impacts of the construction of the NMCIA, through the use of the multi-regional Input-Output Matrix, using investment amounts destined for urban infrastructure projects and their multiplier effects.
The construction of regional Input-Output matrices, is done with the bottom-up approach, because even though this new airport is a project of national importance, its immediate impact during the construction stage will have a more important effect in the surrounding region and local influence area. Therefore, it is required a methodology that "spatializes" the effects and impacts of this new investment and also emphasizes its connection with the functioning and spatial structure of the city, particularly the areas where impacts are concentrated.

The "spatialization" of the Input-Output matrix requires its construction to come from the elaboration of a system of regional and local accounts, and the identification of sectors of economic activity and its transactions, so as to build matrices by economic subregions of the city that will be integrated in a multi-regional input-output matrix.
Subsequently, there is an exploration of the methodologies available for the analysis of impacts, from which the closest are those related to environmental impacts, given that the review of the literature did not revealed any application of the methodology of Input-Output at the intra-urban level. So, according to the design of functional economic regions and particularly urban economic regions and their interactions, as well as through the construction of Input-Output matrix via bottom-up and with the methodological principles of analysis Input-Output more akin to the urban study, a methodological proposal will be integrated for the purpose of observing its results and scope, in order to, subsequently develop a more systematic and rigorous methodology based on the Input-Output approach so as to analyze the economic composition and spatial structure of cities.
Thus, this research is an exploratory analysis, where economic factors are combined with the economic functionality in urban regions and the input-output analysis. It is expected that the results achieved will get close to the measurement of the urban impacts that the region of study will have and more specific, Mexico City´s Metropolitan Area as it is the local impact area with an area of influence, in accordance with the new demands of employment and urban infrastructure in the subregions.

The research methodology has the following steps: 1. Identification of the subregions in the central region of Mexico and in the urban economic region of Mexico City, where this new project is to be implemented; 2. Elaboration of the system of regional and local accounts of the area of study; 3. Construction of the subregional Input-Output Matrix and multi-regional matrix,

considering the established investment for urban infrastructure projects in the relevant sectors; 4. Identification and analysis of urban impacts on the region of interest, resulting from the use of the input-output methodology.

For the construction of the regional input-output matrix, the data comes from the most recent economic census where there is availability of the main macroeconomic variables at the level of basic spatial units and those missing variables will be estimated through the bottom-up approach and with the use of interaction indices that validate intersectoral relationships within the multi-regional Input-Output Matrix.

Keywords: subregional, regional accounts, multi-regional input-output matrix, urban impacts.

## North-South-Divide: How developed nations depend on cheap labour and inequality abroad.

Topic: 811E  Special session: SIC-OECD-IDE/JETRO Joint special sessions on Development, Employment and Inequality (4)
Author: Arne GESCHKE
Co-Authors: Ali Alsamawi, Joy Murray, Manfred LENZEN

Contribution to the Special Session entitled: Labour and development issues

In this study we examine global employment- and inequality footprints. We find that the developed nations in general require more labour to support their lifestyle than they can domestically provide themselves. Hence, in order to support their lifestyle, they are dependent on workers in foreign countries that produce goods and services that form part of the supply chains of consumables bought in developed nations. Developing nations however need to work for their own demands as well as for the demands of the developed nations. This clear master-servant-relationship is further supported by our findings regarding the inequality within different nations. While developed nations often have a higher level of equality across their workforce, developing nations suffer from higher levels of inequality. Through global supply chains, most developed nations indirectly fuel and also benefit from the inequality in developing nations. There are some exceptions: The United States as well as the United Kingdom experience comparable amounts of inequality as their direct and indirect trade partners. Russia has a high within-country inequality nevertheless it has the lowest inequality footprint in the world, which is because of its trade connections with the Commonwealth of Independent States and Europe.

## Brazilian States in Global Value Chains: Spatial Production Systems Interpreted by Feedback Loop Analysis

Topic: 811W  MRIO Modelling and Database
Author: Joaquim J.M. GUILHOTO
Co-Authors: Geoffrey J.D. HEWINGS, Denise IMORI

The underlying geographical structure of global value chains is the object of study in the paper. Our objective is elucidating this geographical structure, with special attention to the spatial interdependencies of Brazilian states, by means of the hierarchical feedback loop methodology. In essence, this methodology offers a detailed view of economic interactions, first by identifying the paths of influence across regions, and then by proposing a hierarchical extraction method to

identify the paths in terms of their economic importance. The application in our paper differs from previous studies adopting this methodology as it takes into account value-added flows involved in the supply chains, rather than interregional gross trade. In the paper, firstly, background perspectives are presented on how the fragmentation of production processes has lead to the reorganization of economic activities around the globe and within countries. Then, the hierarchical feedback loop methodology is applied to a novel country-state input-output table, covering the 27 Brazilian states and 39 foreign countries (and the rest of the world as another country), for the year 2008. Following the macro level application, the paper concludes with an analysis of feedback loops at sectoral level, increasing our understanding of the nature of the inter-regional dependencies. In our empirical results, the dominance of the Southeast region's states, especially São Paulo, in the spatial structure of the Brazilian supply chain networks, is verified. A great degree of production sharing among the Brazilian states is also observed. The results indicate that fragmentation within great regions is a major phenomenon for the Southeast and (secondary to the links with São Paulo) the South regions. For states elsewhere in the country, supply chain connections with the more developed states in Brazil overshadows production sharing with neighbouring states. In this way, the geography of production within Brazil seems to remain quite similar over the years. At global level, a spatial structure is observed where the flows linking major economies across trade blocks are dominant; more than 75% of international supply chain value-added flows link countries in different trading blocks. The fact that supply chains are well defined within blocks is only secondary to this structure. Therefore, our results support the observation that production fragmentation is a truly global phenomenon, not being merely circumscribed to trading blocks.

## An Input-Output Analysis of the U.S. Economy Over the Last Seven Decades

Topic: 516D  Trade in Value-added
Author: Jiemin GUO
Co-Authors: Erich H STRASSNER

The U.S. economy has experienced dramatic changes over the past seven decades.  The economy experienced an  increase in manufacturing and home construction during the post-World War II economic boom in the 1950s; the longest uninterrupted period of economic expansion in history in the 1960s; the problems of the energy shortage, high inflation, and high unemployment in the 1970s; the industrial deregulations in the 1980s; the economic recovery and significant productivity growth in the 1990s, and the new economy dominated by technology expansions that integrated with the global economies in the 21 century.  The U.S. economy has been transformed from a goods-producing dominated economy to service-dominated economy; from internal-depended economy to a more-opened economy.  Using the recently published U.S. historical input-output tables by BEA, this paper attempts to: 1) find the paths of U.S. economic structural changes through the changes in industry relationships; 2) identify the link of the "hollowing out" processes of the U.S. economy with the trend of globalization; and 3) measure analysis of the "trade in value added" for the U.S. economy over time.

## Extended Supply-Use Tables in Basic Prices with Firm Heterogeneity: A Proof of Concept for the United States

Topic: 711W  Special session: APEC TiVA: SUTs with Firm Heterogeneity (1)
Author: Jiemin GUO
Co-Authors: Erich H STRASSNER, James J Fetzer, Thomas F Howells, Zhi Wang

This paper presents proof-of-concept trade-in-value added (TiVA) statistics estimated from extended supply-use tables for the United States that account for firm heterogeneity. The tables used to estimate the TiVA statistics extend recently-introduced supply-use tables for the United States (Young, Howells, Strassner, and Wasshausen, 2015) by disaggregating the components of supply and use by multinational and domestic-only firms using estimates from Fetzer and Strassner, 2015.  Recent research has shown both the advantages of measuring trade on a value added basis when analyzing bilateral trade flows and the dominance of multinational enterprises in U.S. trade in goods and services. Our TiVA statistics for the United States include time-series measures for the period 1997-2013 based on traditional supply-use presentations as well as statistics that reflect firm-level heterogeneity for the year 2011. The comparative analysis of the two sets of statistics allows us to understand better how firms within industries engage in GVCs and if the incorporation of firm heterogeneity provides a more accurate measurement of TiVA.

## Tracing CO2 Emissions Transfer in China’s Domestic Value Chains

Topic: 714F  Environmental IO Modelling (3)
Author: Lin GUO
Co-Authors: Jinjun XUE, Bo MENG

This paper aims to investigate the creation and distribution pattern of CO2 emissions in China’s domestic-interregional value chains. We borrow the idea presented in the recent innovative works by Meng, Peters and Wang (2014) and MRIO model to measure how regional CO2 emissions are transferred and outsourced across China’s domestic regions by various value chain routes from both upstream and downstream perspectives. The main findings of this study based on the downstream oriented decomposition of value chains: 1) For all regions, the CO2 emissions generated by inner-regional final goods and services account for the majority of the total emissions. and the share of CO2 emissions generated by the production of intermediate outflow absorbed by the direct “import” region contribute the largest share of CO2 emissions for extra-regional final demands. 2) The Electricity, supply, metal products, and Non-metallic mineral products and the chemical products accounts for the majority of CO2 emissions as intermediate inputs. The main findings based on the upstream oriented decomposition of value chains: 1) in most regions, CO2 emissions generated in inner-regional segment is the main contributor for total induced CO2 emissions. 2) The majority of induced CO2 emissions in producing inter-regional exports come from the inner-regional side for all regions except the North municipalities. 3) The environmental cost of value-added outflows for island regions are relatively higher than coastal regions, and the cost is decreasing.

# Alternative Growth Scenario and Nutritional Outcome using Recursive Dynamics CGE Approach : A Study of India

Topic: 809D  Special session: Modeling Impacts of Structural Change in Emerging Economies (1)
Author: Mythili GURUMURTHY

1. Introduction and Research Questions
This paper attempts to find nutritional outcome of alternative growth scenario for poor households in India. In particular it asks, if giving impetus to agriculture would translate itself into improved nutritional outcome for the rural poor ? Though India undertook structural reforms and opened up the economy in 1991, there are sufficient documentation that the malnutrition of adult and children is still a grave concern for the planners inspite of many welfare schemes that were launched in the last 2 decades. Agricultural sectoral growth is also diving down. In this background, this study attempts to find if the gloomy prospect of agricultural sector is the major cause, or the problem lies elsewhere.

2. Methodology
The paper uses CGE model of Recursive Dynamics to project results for the future years with reference to BAU and alternative scenarios. The basic model adopts the one by Panda-Ganesh Kumar (2008) for production and consumption structure and made extensions to suit our analysis. The existing CGE model is a static model based on a modified Social Accounting Matrix for the year 2003-04. The specific features of the model are: Intermediate demands follow Leontief's input-output coefficients and the sectoral value added follows CES (constant elasticity of substitution) production function. Households preferences follow LES system of demand  ROW is a single entity in the model It follows Armington specification for trade. To suit our analysis, the following adjustments have been made in the existing  model.
Agricultural sector - In the existing model, the agricultural sector comprises 14 subsectors, 10 for crops and 4 for allied sectors such as Dairy, Fishing, Poultry and other animal products. In the crop sector, coarse cereals are combined into one sector. Since the present analysis focuses on consumption and nutrition, individual crops in the combined coarse cereals, viz. Bajra, Jowar, Maize and others have been separated and the total crops sector is extended from 10 to 13 sectors.
Factor Market Disaggregation - The existing model has only 5 factors, 4 for labour, rural-urban further divided by skilled and unskilled and 1 for capital. Our model has split capital into land, agricultural capital and non-agricultural capital. This was perceived as important for the recursive dynamics where the growth in the land and agricultural capital widely differs from that of non-agricultural capital. Hence to inject growth in the capital , it has become necessary to have these types separately.
Household Classification - The existing SAM has five household classes each for rural and urban areas based on the consumption expenditure. The modified SAM aggregated top 2 and bottom 2 household classes to make only 3 household classes each for rural and urban areas. This was carried out to make the model more meaningful for the future years. There may be households who shift from one group to another and the model is not capable of updating this. The clubbing of finer groups will result in minimum errors.
The following is the final household groups. The classification is based on three expenditure classes each for rural and urban areas and was based on the following monthly per capita expenditure percentiles: Bottom 30% of the population;  30% - 70% of the population ; Top 30% of the population

The model follows 'recursive dynamics' for future projections, wherein interperiod changes are analysed through a series of temporary equilibria. Parametric changes will be fed into the model

to take it to future years. The parametric changes are considered for capital, population growth, labor, Total factor productivity, certain behavioral parameters, government expenditure and foreign inflow and outflow. With 2006/07 as the base year, the model will be simulated for the block years 2009-10 and 2010-20.

3. Data
To study the effect of various policy targets on agriculture in general equilibrium model, a Social Accounting Matrix (SAM) for 2006/07 of India based on the detailed SAM developed by Panda and Ganesh-Kumar (2008) will be used. The SAM comprised 35 sectors, 7 factors of production and 6 categories of households 3 each for rural and urban based on MPCE. The 35 sectors comprised 17 sectors from agriculture, one sector of primary products, 4 sectors of agro-processing, 7 sectors of manufacturing and 6 sectors of services. The SAM was constructed at market prices of the commodities in 2006/07.

4. Novelty of the research
Past studies are mostly based on static model. The present study employs a forward looking approach, by using recursive dynamic model. It will give a useful direction to the policy makers to minimize malnutrition especially of the poor. Alternative scenarios will consist of GDP led growth, agriculture led growth, cereal led growth and non-agriculture led growth at 2 alternative growth rates scenario.

## Gaps in imported intermediate ratio between exporting and non-exporting firms in Japan

Topic: 711W Special session: APEC TiVA: SUTs with Firm Heterogeneity (1)
Author: Satoru HAGINO
Co-Authors: Maki TOKOYAMA

In the context of improving Trade in Value Added (TiVA) indicators, the OECD and relevant countries work on the extension of their supply-use or input-output Tables. Such work is based on the assumption that imported intermediate ratios should be different between exporting and non-exporting firms or between foreign-controlled and domestically-controlled firms. By incorporating such firm heterogeneity in supply-use or input-output tables and using the results in OECD's international input-output table, TiVA indicators are to be more precise and relevant. Since this work uses the approach of existing Trade by Enterprise Characteristics (TEC) Statistics, it is termed TEC plus. This paper tries to prove such an assumption in terms of firm heterogeneity by measuring imported intermediate ratios of exporting and non-exporting firms, as well as domestically and foreign controlled-firms in Japan.

After compiling TEC data for Japan and examining relevance of such data, this paper tackles TEC plus. Specifically, by using firm-level data of the Basic Survey of Japan's Enterprises, it identifies gaps in the use of imported intermediate goods between exporting (engaging in direct exports) and non-exporting firms (not engaging direct exports at all) and/or foreign and domestically-controlled firms in Japan. The estimate reveals that the imported intermediate ratio to output is almost 10 percent higher in exporting firms than in non-exporting firms, and that the gap has expanded in recent years. In terms of the type of ownership, imported intermediate ratio is more than 15 percent higher in foreign-controlled firms, whose majority of ordinary shares or voting power is held by non-residents, than in domestically controlled firms. These results suggest that OECD's assumption holds in Japanese economy.

Then the paper examines the direction of further studies. As far as firms in Japanese economy is concerned, the gap between foreign-controlled and domestically-controlled firms is larger than the gap between exporting and non-exporting firms. However, the magnitude of foreign-controlled firms is limited because the share of their imports and exports is still low. Thus, the priority should be given to the distinction between exporting and non-exporting firms for Japan.

The paper further analyses gaps in imported intermediate ratios of manufacturing industries by measuring gaps by product types using firm-level data of Census and Input Survey of Manufacturers. Interestingly, a clear distinction is found in firm heterogeneity between processing and assembly industries such as electronics and automobiles and primary material industries such as chemicals and textiles.
In processing and assembly industries, largest gaps are found in products that are produced by a focused industry, typically electronic products in electronics industry and transport machinery products in transport machinery industry, and such gaps can be incorporated into Japan's Import table without further thought. In contrast, in primary material industries, negative gaps were found in products that are produced by a focused industry, typically chemical products in chemistry industry and textile products in textile industry.
Through more detailed data analysis, the paper reveals that negative gaps in primary material industries are due to their division of production process. For example, in chemical industry, there are several large firms that import materials and produce export goods with integrated production systems. At the same time, many medium-size firms co-exist and they rather engage in a certain part of production system, importing materials and provide intermediates only to local firms. Such findings cast a question about the understanding of firm heterogeneity in terms of intermediate imports and its treatment in the supply-use or input-output table.

## Decomposition of Average Propagation Length

Topic: 809W  Methodological Aspects of MRIO Analysis
Author: Taiji HAGIWARA

[Background]

Dietzenbacher proposed the concept of Average Propagation Length (APL) (Dietzenbacher et al (2005) and Dietzenbacher et al (2007)). APL has been used as length of production process or length of supply chain. On the other hand, international division of labor in the production process is getting focused in face to globalization. The phenomenon of increasing cross-border transaction of intermediate inputs is called the fragmentation of production process. APL is used as index of fragmentation of production process (Romero et al (2009), Escaith et al (2013)).

[Research Question]

Since APL includes both propagation in domestic transaction and that in cross-border transaction, two propagations should be separated in order to analyze fragmentation. In this presentation, I propose cross-border APL (APLxB) and the method of APL decomposition in general.

[Method used]
Let's assume world input-output table with R country an N sector (RN x RN matrix). Let a(i,j,r,s) be a input coefficient of s-th country j-th sector purchase of r-th country i-th sector

commodity. The input coefficient matrix (A: (RN x RN)) can be divided into two sub-matrices, international transaction matrix Af and domestic transaction matrix Ad. The size of both matrices is (RN x RN). Ad includes factors a(i,j,s,s) and zeros for all r ><s. Af includes factors a(i,j,r,s) for r><s and zeros for all r=s. Then, it holds A=Ad+Af.

APL is the fraction of the sum of (k*A^k for k=1,2,3...) and the sum of (A^k for k=1,2,3...). The numerator of the cross-border APL is sum of following T(k), for k=1,2,3...

T(1)=1*Af + 0*Ad
T(2)=2*Af^2 + 1*(Af*Ad+Ad*Af)+0*Ad^2
T(3)=3*Af^3 + 2*(Af^2*Ad+Af*Ad*Af+Ad*Af^2) + 1*(Af*Ad^2+Ad*Af*Ad+Ad^2*Af) + 0*Ad^3
....

These terms T(k) look very complicated and difficult to calculate when k goes large. However, T(k) can be expressed as rather simple difference equation and its proof is given the paper.

More in general, let Aq be sub-matrices of A and sum of Aq equals to A. Then the same method above can be applied. Therefore, APL can be decomposed to the length passing through Aq.

[Data used]

WIOD data is applied to show the result of APLxB and decomposition of APL. Main result is that most of the APL is passing through the country of demand origin or the country of production.

[Novelty of the Research]

(1) It proposes the concept of cross-border APL
(2) It proposes the decomposition of APL
(3) It shows cross border and domestic APL using WIOD.

Reference

Dietzenbacher, E., I. Romero and N.S. Bosma (2005), "Using Average Propagation Lengths to Identify Production Chains in the Andalusian Economy", Estudios de Economia Aplicada, vol.23,no.2, pp.405-422

Dietzenbacher,E. and I. Romero (2007), “Production Chains in an Interregional Framework: Identification by Means of Average Propagation Lengths", International Regional Science Review, vol.30,no.4, pp.362-383.

Escaith,H. and S.Inomata (2013), "Geometry of global value chains in East Asia: the role of industrial networks and trade policies",Global value chains in a changing world(D.K.Elms and P. Low eds.) WTO, pp.135-157

Romero,I., E.Dietzenbacher and G.Hewings (2009) "Fragmentation and Complexity: Analysing Structural Change in the Chicago Regional Economy", Revista de Economía Mundial, vol.23,pp.263–282

## Drivers of the Malaysian economy under dualistic trade structures

Topic: 814Z International Trade (3)
Author: Nur adilah HAMID
Co-Authors: M. Yusof SAARI, Azman HASSAN, Chakrin UTIT

Exports of the manufactured products, in particular electric and electronic products are found to be major contributor to the total exports of goods in Malaysia. Production of exports for the electric and electronic products in Malaysia is mainly involved processing trade activities. These economic activities commonly take place in Free Industrial Zones. With the growth of 101% between 2000 and 2014, the processing trade activities making Malaysia is one of the countries that actively participating in the Asian region. Empirical evidences from other countries clearly indicate the unfavorable effects of these trade activities on domestic economies with lower contribution to value added and employment. Nevertheless, empirical works to quantify the economic impacts of processing trade activities in Malaysia are clearly lagged behind. Thus, this paper aims to extensively evaluate the impacts of processing trade activities on the Malaysian economy by paying specific attention on value added, employment and productivity. An extended input output table will be developed to segregate processing trade from normal trade with help from trade statistics for goods and services, and economic census. Results from this paper would not only add into the current literature but also would provide significant policy responses to the government in particular with respect to the effectiveness of Free Industrial Zones in promoting economic growth and societal welfare in Malaysia.

## Prediction of economic impact brought about by the increase of non-metallic mineral wastes in Japan

Topic: 814E Special session: Economic and Environmental Relationship in Asian-Pacific (2)
Author: Ryoji HASEGAWA
Co-Authors: Hirofumi Nakayama, Takayuki Shimaoka

Non-metallic mineral wastes accounted for a large part of industrial waste generated in Japan and they have a significant influence on the material flow of waste due to their large amount. In order to establish a recycling society, it is essential to reduce the amount of final disposal of such material and the efficient use of non-metallic mineral wastes is to be more promoted. However, lately a decrease in demand for this material is anticipated—commencing with the construction industry—and there is concern that the balance of supply and demand for non-metallic mineral circulating resources might collapse. In light of this, this study predicts the amount of final disposal of non-metallic mineral wastes and its influences to industries in the future under assumption of several social situations by using linear programming and input-output table developed for non-metallic mineral materials. Considering the empirical results, we discuss the efficient use of non-metallic mineral waste and its effect.
Keywords: non-metallic mineral waste, material flow, balance of supply-demand, linear programming, input-output table

## Economic Shocks and Changes in Global Production Structure: Evidence from Annual Inter Country Input-Output Tables for 1995-2011

Topic: 811Z International Trade (2)
Author: Yoshihiro HASHIGUCHI
Co-Authors: Colin WEBB, Norihiko YAMANO

Conventional studies into the impacts of economic shocks using global input-output tables (sensitivity analyses) assume stable production structures and thus, only reveal the marginal impacts of changes in final demand. However, when economic shocks occur, whether at home or abroad, economic agents are expected to react to reduce the negative feedbacks or to amplify the positive effects. The ability of a country to alleviate the economic losses can be defined as the resilience to economic shocks . Using the OECD's annual Inter-Country Input-Output (ICIO) tables, 1995 to 2011, this paper investigates the relationship between changes in final demand and production structures, over the longer term trend and during the economic crisis, for 61 economies. Our first results suggest that in recent years the extent of negative ripple effects on the economy has decreased in many countries. This can be attributed to changes in the composition of value added i.e. labour and capital contributions to output and, foreign propagation in output (Leontief) multipliers.

## Intra- and Inter-regional Economic Effects of the Population Flow after the Great East Japan Earthquake

Topic: 811B Disaster Analysis
Author: Ryoma HASHIMOTO
Co-Authors: Shigemi Kagawa

The Great East Japan Earthquake occurred in the Tohoku and Kanto regions in March 2011 and it has brought about the serious economic and social damage in those regions directly (Reconstruction Agency of Japan, 2014). In particular, three prefectures of Miyagi, Fukushima and Iwate have still suffered from that not only many residents in those prefectures evacuated to another prefecture but many producers in agriculture and manufacturing struggle to employ workers. The former has contributed to the decrease in final demand in the region, whereas the latter has contributed to the decline in production through supply constraint due to the lack of sufficient labor inputs.

With this background, Miyazato (2014) extended the disaster input-output model developed by Steenge and Bockarjova (2007) into a multi-regional framework with a focus on the 47 Japanese prefectures and estimated the economic damage through the labor supply constraints in the above three prefectures. In particular, Fukushima has been significantly affected by the earthquake and its economic damage amounts to 296 billion yen which is 5% of the gross prefectural product.

However, the multi-regional input-output frameworks do not model a relationship between population flows over regions and regional economies well. This study develops a disaster multi-regional input-output framework including the population dynamics. We applied the proposed disaster framework to the multi-regional input-output (MRIO) table covering 80 industry sectors and 47 Japanese prefectures in 2005 (Hasegawa et al., 2015). The MRIO data used in this study is accessible from the website:

http://www.journalofeconomicstructures.com/content/4/1/5/additional
and the population statistics of provided by the 47 prefectural governments is used. The results focused on the study period during March 2011 to March 2015 highlight the intra- and inter-regional economic impacts of evacuating from three disaster regions, Fukushima, Iwate and Miyagi to the other regions and suggests a regional policy of how the evacuated people could return to the disaster regions again.

## Beyond Intermediates: The Role of Consumption and Commuting in the Construction of Local Input-Output Tables

Topic: 714Z  IO Accounts and Statistics (2)
Author: Kristinn HERMANNSSON

Estimating intermediate trade using non-survey methods produces biased results. This has led to a methodological recommendation which emphasises the accurate estimation of intermediate trade flows. This paper argues for a qualification of the consensus view: When simulating IO tables, construction approaches need also to consider spill-over effects driven by wage and consumption flows. In particular for metropolitan economies, wage and consumption flows are important to obtain accurate Type II multipliers. This is demonstrated by constructing an interregional Input-Output table, which captures the interdependence between a city and its commuter belt, nested within the wider regional economy.

JEL Codes: C67; R12; R15; R23.
Keywords: Input Output; Location Quotients; Commuting; Consumption; Glasgow; Scotland.

## Expenditure and Displacement Impacts of Students' Consumption: Interregional Input-Output Analysis of a City-Region

Topic: 814A  Regional IO Modelling (3)
Author: Kristinn HERMANNSSON

University students generate positive expenditure effects where they study and negative expenditure displacement effects at their place of origin. This paper specifies a model to estimate the magnitude of these impacts. Spatial expenditure/displacement profiles are constructed by combining information on students' consumption and the location of their places of origin, study and term time residence. An input-output model captures the dependence between a major student centre, the surrounding city region and the wider regional economy. The analysis reveals positive expenditure effects to the city and spill-over effects to the surrounding city region. Negative net-migration
of students triggers expenditure displacement.
JEL Codes: I23, I25, R12, R15
Keywords: Input-Output, Metropolitan, Impact, Higher Education, Students, Expenditures, Displacement

## The evolution of income inequality in Chicago: Test for the trickle-down effects using an input-output model

Topic: 516B  Special session: The Use of Open, Semi-Closed and Closed IO Models; Theory and Application
Author: Geoffrey J.D. HEWINGS
Co-Authors: Kijin KIM

Abstract: Income equality in the US has been deteriorating over the past several decades in large part due to declining middle-income family shares.  Despite the growing global- and nation-wide concerns about deepening income inequality, the same issue at the sub-national level has not been investigated as comprehensively as at the higher geographical levels.  This paper explores the evolution of income inequality in Chicago for the past three decades.  We are particularly interested in assessing the dynamics of income distribution in the Chicago economy that has experienced dramatic structural characterized by an “hollowing-out” process (Hewings et al., 1988).  The extended input-output framework proposed Miyazawa (1968) is implemented to account for the heterogeneity of households by income group.  Following Kim et al. (2015) and Kim and Hewings (2015), the time series of the Chicago’s input-output tables are disaggregated by income group using Census microdata and simulated data.  Empirical test for the trickle-down effects are conducted by examining the progression of the Miyazawa’s interrelational income multipliers that capture how one unit of labor income shock in one income group is transmitted to the labor income of other income groups.

## A General Equilibrium Approach to Nepal Earthquake Recovery Policy with Renewable Energy Implementation

Topic: 514A  Special session: Science for Re-designing Science, Technology and Innovation (SciREX) Policy
Author: Michael C. HUANG
Co-Authors: Damaru Ballabha Paudel

The study develops a practical and quantitative disaster impact assessment using a general equilibrium approach of a recursive model. The framework will provide the quantified economic impact and examine the effectiveness of implementing renewable energy on the recovery for 2015 Nepal Earthquake. More specifically, the research will estimate losses production factors (e.g. capital, labor) and a new composite of power generation with newly energy infrastructure invested. The evidence-based framework is expected to visualize its fiscal and social cost of the recovery process and actualize to build back better with resilient energy. The research will be conducted by using general equilibrium analysis to construct a disaster impact assessments and recovery framework through various policy simulations.
The study is based on Nepalese 2011 Input-Output Table, and furthermore, the compilation of the input-output table of renewable energy (e.g. solar power and Hydro power) will be conducted based on the field study survey for obtaining the realistic information of power capacity and costs of infrastructure. Finally, this model is applied to examine the effects of renewable energy to implementation as recovery policies in response to an earthquake disaster. The disaster impact assessments and the input-output table for renewable energy will make it possible to construct a CGE model for making the disaster recovery policy simulations with implementation of renewable energy.

## How important is a structural change to employment development: a comparison of Germany vs. Slovakia

Topic: 716X  Employment Analysis (2)
Author: Martin HUDCOVSKY
Co-Authors: Jozef KUBALA

The employment levels of Central and Eastern European countries are even after two decades of transformation process not reaching the employment levels of developed Western countries. This phenomenon can be clearly observed on case of employment development in Germany vs. Slovakia.  The paper utilizes structural decomposition analysis for these countries within 1995 – 2009 time-frame based on World Input-Output Database in order to bring some light into the importance of structural change in employment development. Beside typical and deeply analysed contribution of labour productivity change, also the contribution of other determinants, such as share of imported intermediates on total intermediates, technology change and change in structure of final demand is elaborated. Various dimensions of final demand structure are analysed with orientation on industrial and sectorial structure. The decomposition provides new results with aim to better understand the role of structural changes in the labour market of post-transformed economies.

## Transnational Interregional Water Footprint Analysis in China and South Korea and Japan

Topic: 714E  Special session: Economic and Environmental Relationship in Asian-Pacific (1)
Author: Taku ISHIRO

The 10th meeting of the Conference of the Parties (COP10) to the Convention on Biological Diversity (CBD) ended in Nagoya, Aichi Prefecture, on Oct. 30. 2010. Previously, The Millennium Ecosystem Assessment (MA) concluded concludes that human activity is having a significant and escalating impact on the biodiversity of world ecosystems, reducing both their resilience and biocapacity. Additionally, MA included the sub-global assessment (SGA) that is the assessment of regional, watershed, state as well as the global scale. In Japan SATOYAMA SATOMI SGA is put into practice by using SGA framework. We chose the Hokkaido Tohoku Kanto-Chubu Hokuriku Nishi-nihon cluster as the area of SATOYAMA SATOMI SGA. Above all, Kanto-Chubu cluster has four sites that is Kanagawa Tochigi Chiba Tokyo and the scope of target is Tokyo Bay, Naka River, Ise Bay, Mikawa Bay. The author collaborates with the researcher of Kanagawa site and studies the impact of ecological system through the change of socio-economy of Kanagawa, Ishiro and Hasebe(2010). Secondly the author expands this research framework into interregional relation about Kanto area, Ishiro (2011) and transnational interregional relation in China and Japan, Ishiro(2012).
On the other hand, author develops an analysis about international division of labor of the East Asia by compilation of transnational interregional input-output table in China and South Korea and Japan. According to the results of this analysis, in Japan, China, South Korean three countries, the division of labor between the international areas across the country becomes active.
Based on this analysis, the objective of this paper is to clarify the relation between economic activity and structure of water inducement among East Asian countries taking author’s research one step further.
Especially, having regard to the fact that trade with other country's region is essential to regional activity in recent years, the main purpose is to see how trading of each region in Japan and China and South Korea affects the water inducement of each region and countries.

There are previous studies, Okadera, Fujita, Watanabe and Suzuki (2005), Shimoda Watanabe, Yue, and Fujikawa (2009) that has common awareness of the issues. The former analyzes water inducement by the Kanto interregional input output table they made. The latter analyzes environmental load including water inducement by Asian international input output table. On the other hand, our study analyzes transnational interregional water inducement by the Transnational Interregional Input-Output Table in China and South Korea and Japan dividing Kanto region in Japan into 11 regions.

## Correlation Analysis between Embodies Emissions and Revealed Comparative Advantage(RCA)

Topic: 809F  Environmental IO Modelling (4)
Author: Miran JANG

Policies to reduce Greenhouse Gas Emissions induce changes of economy. The economy of South Korea, which highly relies on trade, would respond to carbon taxes as the price of exports is incremented by the imposed carbon taxes on exports. In this sense, adaptation to carbon-tax-induced changes in exports is very important study area for policy makers.
This is a baseline study for the adaptation to carbon-tax-induced changes in exports in South Korea. This study aims to predict the vulnerable industries to a carbon tax and to analyze emission trends in competitive industries. In order to achieve these goals, we identify industries that emit large amount of CO2 to produce and consume one unit of exports and examine the correlation analysis between competitiveness in exports and the embodied CO2 in one unit of exports.
Focusing on South Korea, we use Single Regional Input Output (SRIO) method for the estimation of embodied CO2 emissions in exports. For the competitiveness in exports, the traditional Revealed Comparative Advantage (TRCA) index and the new measure of RCA (NRCA for short) developed by Wang et al. (2014) are used. NRCA only takes into account the domestic value added, while TRCA considers gross export including both domestic and foreign value added. In this regards, utilization of NRCA index for estimation of industrial competitiveness in exports enables in depth analysis on pure competitiveness in exports of South Korea.
Applying the SRIO method to the World Input-Output Database (WIOD), we produce new panel data sets that reveal the embodied CO2 emissions of 35 industries in the Korean economy. Data source for the embodied emissions in export is World Input Output table (WIOT) covering 40 countries from 2000 to 2009 and the WIOD's environment account of CO2 emissions. Furthermore, RCA indices are estimated using WIOT from 1995 to 2011. The different time coverage occurs when WIOT and WIOD's environmental account provide the different up to date data of 2011 and 2009, respectively.
The motivation for this study comes from intuitive expectation that competitiveness in export has inverse relation to embodied emission in one unit of exports. However, it is revealed that there is no distinct relationship between the two indicators. A pattern, in the meantime, can be found that industries embodying low CO2 emission per a unit of export and gaining big competitive advantages tend to export relatively large amount of commodities. From this result, it can be assumed that industries highly contributing to the gross exports are less vulnerable to carbon taxes as the embodied CO2 emissions in a unit of export is lower than the other industries.

Besides, it is identified that vulnerable industries to carbon taxes are Wood and Products of Wood and Cork, Agriculture•Forestry•Fishery, Basic Metals and Fabricated Metal, and Transportation.
Lastly, the correlation analysis represents a tendency for industries having the low embodied emissions in one unit of exports and a big RCA. As time passes, the industrial competitiveness in

exports increases, while the level of embodied emission per a unit of export decreases in most of industries gained big RCAs.
The major contribution of this paper is to generate a time series data of embodied CO2 emission for the recent 10 years. This enables for the trend analysis of the embodied emissions in exports by industries. The other contribution is to apply NRCA index to correlation analysis. NRCA index does not underestimate the competitiveness in exports by considering the value added only created in the domestic market. Since this study focuses on a domestic production and consumption process, SRIO analysis is appropriate. However, future research suggestion is to utilize MRIO method for estimation of the embodied CO2 emissions in order to take into account global production chains.

## Strategies for dissemination of input-output data and analyses. Comparison of Statistics Denmark and other national statistical institutes.

Topic: 711Z Special session: Compilation Issues of Supply, Use and Input-Output Tables
Author: Peter R. JENSEN

In most countries the compilation of input-output tables is done by national statistical institutes or some other government institution. In order for the users to have the best possible access to these data it is very important that the dissemination of data and various bi-products in terms of analyses, teaching and other kinds of support is in line with what the users require. It is the experience in Denmark that there is an increasing awareness that input-output data is relevant to use for various analyses but also that there is an increasing demand for processed data in terms of various multipliers and other types of analyses due to an inability of many users to make their own calculations. The paper discusses the various actions that are being taken by Statistics Denmark to disseminate data as well as analyses in the best possible way. Data are downloadable from a database as well as full tables in GAUSS, GAMS, Excel and SAS formats. In the near future the strategy is to make available more up-to-date tables (t-1), tables with a range of multipliers and tables with SUT-data (CPA and SITC classification) as only the compiled input-output tables are published now. Moreover, it is the intention to publish more input-output based analyses and to work harder to draw the attention of the media to the results. Alongside with this discussion a closer look is taken at what goes on in this field in some other countries and a conclusion is drawn as to whether Statistics Denmark is on the right track.

## Analyzing Important Elasticity Parameters of a Korean CGE Model

Topic: 714C Special session: Computable General Equilibrium Modeling for Policy Impact Analysis
Author: Kiho JEONG
Co-Authors: Seongyoon HWANG, Dongsu LEE

Although Computable General Equilibrium (CGE) models are now widely used in fields of energy, environment and economy to assess policy impact, they are often criticized as most key parameters are not econometrically estimated. Since the models are often large in scale, however, econometric estimation of parameters is costly, particularly in constructing huge database. Identifying important parameters would be useful as resources and information could be efficiently concentrated on them. This paper employs a novel approach of Belgodere and Vellutini (2011) to the identification of important parameters of an economy-energy-environment CGE model for the Korean economy. In the approach, (i) after a CGE model is constructed,

parameter values denoted as X are randomly drawn via a Monte Carlo simulation, (ii) outcomes of the CGE model, denoted as Y, are calculated given the parameter values, (iii) the procedures are repeated N times to yield sample data of X and Y with size N, and (iv) finally a standard regression analysis estimates and tests the relationship of X and Y. Using the approach, this paper illustrates how to identify and rank key parameters of the Korean CGE model in impact analysis of an emission reduction policy. We depart from BV's framework in several points. First, BV used an economy CGE model for Cameroon, in which the impact of Economic Partnership Agreement (EPA) with the EU was assessed. We construct an economy-energy- environment CGE model for Korea and consider the impact of an emission reduction policy. Second, BV's model had four classes of elasticity parameters; demand elasticities for each of 42 commodities, elasticities of factor substitution, Armington elasticities, and finally transformation elasticities. Our model is more complex, having 20 classes of elasticity parameters, although commodities are classified into 37 ones, less than BV's 42. Finally, BV just identified statistically significant parameters in the applied model, while we rank key parameters in order of their standardized influence on model results in addition to the identification.

## Separating and Reflecting Technical Change into Tomato Sector in Korean IO

Topic: 814C  Special session:Economic Impacts of Specific Foods: Kimchi, Tsukemono, Tomato
Author: Kiho JEONG
Co-Authors: Dongsu LEE

This study considers issue on how to incorporate technical change of a commodity sector not classified even in the most detailed classification into input-output table.  Recently a new cultivation technology of tomato has been developed by government-funded R&D in Korea. In Korea, a government funded R&D of agricultural sector is subject to economic impact assessment, mainly by input-output method. Tomato is not classified as a commodity sector but is included in vegetable sector in basic commodity classification of Korean input-output table, the most detailed classification.
Focusing on this case, we suggest a practical approach on how to separate tomato sector as a commodity sector and to incorporate the new tomato cultivation technolgy into the 2010 Korean input-output table.  In the approach, firstly, we separate the tomato sector from the vegetable sector using MRAS and TRAS. Secondly, we take a survey from tamato farmers to investigate the change of input structure of tomato sector induced by the new technology and estimate the new technology's technical coefficient vector using the survey results. Lastly, the composite new technical coefficient vector of tomato sector is computed by a weighted average of old technical cofficient vector and new vector, where the weight of the new one is the fraction of total output for tomato sector using the new technology. This new composite technical vector replaces the old one in 2010 input-output table. Our main contribution is to provide a practical procedure on how to modify input-output table by incorporating technical change of a commodity sector not classified.

# Geographical concentration of supply chains and its implication for economic growth. An input-output approach.

Topic: 716E Special session: SIC-OECD-IDE/JETRO Joint special sessions on Development, Employment and Inequality (2)
Author: Sofía JIMÉNEZ
Co-Authors: Erik DIETZENBACHER, Rosa DUARTE, Julio Sánchez Chóliz

Since the decade of the 90s, there has been a process of globalization that has externalized the supply chains of goods and services. The international expansion of the supply chains has allowed enterprises to get intermediate products more easily and at lower costs. However, this process may also increase the risks associated to disruptions in both, the supply and demand sides in the different countries involved.

This topic has been extensively studied in the enterprises or business literature. For instance, Wagner (2007) explains the supply chain risks together with the importance of its management that has having a great interest because the frequency and intensity of catastrophes, disasters and crisis, which seem to have increased along the lasts years. So, we can say that global supply chains 'work' in an increasingly uncertain environment. Also talks about a tendency that is happening in current years. Enterprises 'live' in really globalize and competitive world, so their main objective is to have an efficient production process. Because of that it is observed a tendency to outsource, reduce inventories and to streamlining the supply base. So, we can say that this is generating dependencies between enterprises. Around this topic other papers has made empirical analysis; as could be the case of Thun (2009) that studies the case of automotive industry in Germany or Blome (2011) that analyze risk of supply chains in the case of financial crisis. Following this line of argumentation we can mention Choi (2005) that shows that general companies reduce the number of suppliers in their supply base, which is called 'supply base optimization'. The objective of this is to reduce the administrative and transaction costs. Some examples are General Motors (GM) and General Electric (GE). Tang (2006) also investigated about the increasing uncertainty and vulnerability. In fact, Norman (2004) and Johnson focus theirs studies in particular industries. In the first case it is analyzed the case of Ericsson's consequences after a sub-supplier accident and the second one center their investigation in the toy industry, whose behavior can be teach us how to manage risk in high-tech firms.

To sum up, taking into account the different papers that we have mentioned we can say that in all cases are observed two trends: outsourcing and reducing of suppliers. These increase the vulnerability of enterprises that are more exposed to the risks of a globalized world, and have great levels of dependence, mainly of their suppliers.

Despite the relevance of the topic for economic growth, as far as we know, there are not papers exploring this issue at the meso and macro levels. In this regard, making use of the WIOD database, and more specifically, the MRIO tables, our aim is to analyze the concentration of supply chains in the world economies, its evolution and significance between 1996 and 2009. To do this, after a review of the literature, we consider, as a first step, the use of the Herfindahl index as indicator of concentration. We explore the concentration of the supply chains at different scales: data by countries, sectorial blocks or sectors. Similarly, we focus on matrices A, capturing direct relations between countries as well as on A+A2 and on (I-A)-1-I (with the objective including indirect relationships).

Although preliminary, our results offer some interesting insights. For instance, in 1996, almost all countries had moderate or high levels of concentration, being the most remarkable countries Mexico and Canada. This fact can reflect the NAFTA agreements that are observed between Canada, Mexico and USA. It is also interesting the evolution observed in European countries. Herfindahl index decreases in some of them, getting values below 1000. In that way, we could highlight the tendency of European countries to diversify external supply (although Herfindahl

index is near 1000 in most cases) and the tendency to import supply from Rest of World that includes Latin American countries, Africa…whose level of development is lower than the studied countries and labour costs are lower too, as wages get lower values. The analysis is completed with a study of sectoral behaviors.

## Growth, R&D expenditure and spillover effects: An input-output approach.

Topic: 809B  Innovation and Technological Transfer
Author: Sofía JIMÉNEZ
Co-Authors: Rosa DUARTE, Julio Sánchez Chóliz

R&D expenditure seems to be key explaining economic growth in developed countries. Some papers have attempted to analyse the effect of R&D expenditure realized in a particular sector over others. We can mention papers such as Tsai, K-H et al. (2004), Bernstein, J. I (1999) or Berdnt, E.R. (1995) focused on specific sectors such as manufacturing sectors or high-tech industry. In this paper, on the basis of Ten Raa, T et al. (2000), that suggest an alternative way to calculate spillover effects of R&D expenditure and its effect over total factor productivity and Antonelli (2015) that captures the role of knowledge externalities over productivity making use of input-output tables of 15 countries, we deal with two interesting topics. First, we calculate within a multiregional framework relationship between growth and R&D spillovers from two perspectives: final consumption (R&D embodied in final demand) and production (R&D invested). The second approximation is related with the distribution of the embodied R&D effect over economic growth.
Empirically, we use MRIO-WIOD (1995 to 2011) to as well as R&D expenditure information provided by the OECD databases.
Preliminary results seem to reflect that the countries that achieve the most important role from both perspectives are USA, Japan and Germany, although scenery changes when we introduce China. In general, it is observed an increase in the number of ‘characters’ along the period studied. If we pay attention on R&D embodied and invested coming from non-domestic countries we can observe that other countries gain relevance; Mexico and Canada in the case of R&D embodied  perspective (surely due to their relationships with USA), France, UK or Italy in the case R&D invested  perspective (probably as an indicator of European agreements). It is also remarkable the Chinese case, which, at the end of the period, get high values as an indicator of the current externalization of this country. Respect to sectors behavior, it is possible to observe a common pattern between  countries , being the sectors where we find the highest level of, both, R&D embodied and R&D invested Rest of services, Transport equipment and Electrical and optical equipment. These results seem to be coherent with data used, as great part of R&D expenditure is done in high-tech industry sectors or in Rest of services.
Once a first picture of R&D flows in the world economy is obtained, the other question we try to analyze in this paper is the effect of this R&D over economic growth. In that way, we can expect that direct and indirect R&D expenditure has a positive effect over productivity and, so, over economic growth. However, in our opinion this effect is not immediate. It has to pass some time until these effects are visible in the economy; in other words, there is a gap between R&D investment and its effect on productivity and growth. We approximate to this idea using econometric techniques. Translated this into econometric terms, it means that the relationship between economic growth and R&D has not linear features. In order to study what kind of regression adjusts better, we use minimum least squares and non-parametric estimators, particularly local linear lest squares following the methodology explained by Racine. S (2008).

# Green energy & local economic development: Mapping impacts of solar scale up on Indian economy

Topic: 714Y Special session: Economic and Environmental Impacts of Renewable Energy Targets in Asia
Author: Surabhi R. JOSHI
Co-Authors: Pritee Sharma

Policy decision to logarithmically scale up solar generation capacities in India (100 GW by 2022) may not only transform existing, predominantly coal based energy mix for the economy but also usher opportunities for regional economic growth and development. This paper studies micro economic impacts of solar technology scale up on India economy by constructing a Social Accounting Matrix ( SAM ) simulating impacts of solar deployment as new production activity in Indian economy .

Deployment of a new solar capacities would not only create direct and indirect sectoral demand but also concomitantly generate local employment and wage incomes . As Indian solar policy distinguishes between projects using imported and domestically manufactured solar panels, Independent solar I-O blocks are constructed and integrated as a new sector in 35x35 national input output table (2011) obtained from world input output databases (WIOD) . Wage incomes associated with installation of a unit of grid connected ground mounted photovoltaic solar power capacity in India is estimated in terms of skill based labour compensation generation using WIOD -SEA database.

SAM depicts solar deployment leading to income generation which in turn are allocated to institutional sectors. The impacts in the study are distributed between two economic agents house holds getting labor incomes and private corporations getting capital gains. The house holds are categorized into nine groups on the basis of occupation. The relationship between production structure , income distribution and consumption profile of nine household groups is harmonized for the analysis.

Data from National sample survey (68th round ,2011) on household consumption expenditure, employment and unemployment indicators and status of education and vocational training was used to create consumption and income distribution profile of the nine household categories. The concordance was set between WIOD 35 sector classification, NSSO commodity classification and National Industry Classification (NIC) 2008 .

The analysis reveals greater wage generation for urban house hold in medium and high skill category associated with current solar deployment strategy. The study also highlights the fact that projects using domestically manufactured solar panels provide comparatively wider distribution of wages across the house hold categories and with better penetration in lower deciles of per capita expenditure.

Keywords: Socio economic impacts, Renewable energy, Indian solar policy, Social Accounting Matrix, Regional development

# An Evaluation of Public Procurement Import Penetration: Liberalisation Effects of Preferential Trade Agreements for South Korea

Topic: 516X Regional Trade Agreement and Trade Governance
Author: Surabhi R. JOSHI
Co-Authors: Sangeeta Khorana

Context and Objectives: The study on South Korea evaluates the impact of Preferential Trade Agreements (PTA) on procurement liberalisation and import penetration negotiated/offered under WTO-GPA. WTO-GPA is a plurilateral agreement that facilitates procurement liberalisation among the WTO members that are signatories to the Agreement. PTAs negotiations are driven by partner countries' aim to liberalise trade such that tariffs and non tariff barriers are reduced/eliminated. South Korea acceded to the WTO-GPA accession in 1994, and signed three PTAs: Singapore (2006), European Free Trade Agreement (2006) and EU 28 (2011), with GPA member countries.

This paper maps changes in the volume and composition of sectoral imports for public procurements covered under the WTO GPA agreement as well as pre and post PTAs. We estimate the impact in terms of GDP, welfare impacts, allocative and distributive efficiencies as well as employment generation for the two scenarios, i.e. liberalisation through WTO-GPA and PTAs. In addition, we examine the ex-post impact of public procurement liberalisation achieved under the PTA and WTO-GPA regime by assessing the pros and cons associated with greater market penetration. The approach employs a bottom-up approach of analysis by aligning entity level demand for the public procurement market, and discusses the possible design of appropriate strategies for enhancing trade balance.

Data sources: The paper draws on data from several sources. The data on sector wise GPA imports (volume) are obtained from procurement statistics reported under Article XIX: 5 of the WTO-GPA; this is available for 2002, 2003, 2004 and 2010. This includes services and commodities demand reported by GPA member countries under Annexure I, II and III of the WTO-GPA. The aggregated data is compiled by sectoral classification in the Common Procurement Vocabulary (CPV). As a next step, the CPV sectoral classifications is concorded with 35-sector national Inout Output tables available in the World Input Output Database for South Korea. On the lines of GPA reports 2002-2004 are the basis for pre PTA analysis while the data for 2010 is the basis for post PTA analysis.

Methodology: An input output analysis is performed for the four year data segregated as pre and post PTA scenario. The sector specific impacts on GDP and employment are analysed along with sectoral import penetration profile. The results indicate greater and wider import penetration across economy in both service and product sectors post PTA. Further, the overall (direct and indirect) decrease in domestic demand created through public procurement markets is 34.5 % more in post PTA scenario. The probable decrease in domestic employment generation under the post PTA scenario is 41.5 %, higher than under the pre PTA scenario.

This study differentiates itself by providing ex post impact analysis of PTA in public procurement liberalisation under WTO-GPA regime for South Korea . As public procurement markets have been closely protected and strongly associated with public welfare impacts , pros and cons associated with greater penetration need to be scrutinised both for its allocative and distributive efficiencies. Further as current analysis uses a bottom up framework it can be easily applied for realigning entity level demand associated with public procurement market thus designing appropriate strategies for enhancing favourable trade balance & dynamics.

## Technology and Skill Upgrading Effects of Globalization: An Applied General Equilibrium Approach

Topic: 811C  CGE/econometric IO Modelling (2)
Author: Jaewon JUNG

The globalization process has been intensified at an unprecedented speed over the last decades due to revolutionary advances in transportation and communication technologies. Over the last decades, applied general equilibrium – also referred to as computable general equilibrium (CGE) – models have accordingly widely been used by governmental organizations and academic institutions to analyze the economy-wide effects of various globalization processes, and have become an indispensable tool of modern quantitative policy analysis in all field of economics. Though there have been considerable advances in CGE models over the last decades, however, the representative agent frameworks have been criticized as overly simplistic to reflect the real world. Indeed, recent rapidly growing firm heterogeneity and/or assignment and globalization literatures in international trade study the equilibrium skill allocation to different technologies, and have been highlighting that equilibrium matching between technology and skill itself would have considerable implications for economic performance as well as for any welfare implications.

In this paper, we aim at providing a new basic CGE framework incorporating both firm and worker heterogeneity, and thus allowing for analyzing the technology and skill upgrading effects of globalization: heterogeneous workers choose tasks (or occupations) based on their own comparative advantage, and since each task (or occupation) requires a specific-technology workers' productivity reflects not only their own skill level but also the task/occupation-specific technology they are employing in equilibrium. After constructing a base framework that can easily be extended to various large-scale CGE models, we highlight the quantitative importance of such new framework compared to previous conventional homogeneous agent framework. In particular, we show that economic integration between countries with various sectorial and country-level technological and skill gaps induces considerable quantitative implications based on such technology and skill upgrading or downgrading mechanisms, which could not be captured by conventional CGE models with homogeneous agents.

## Investigation on CGE Models for Disaster Impact Analysis: Implications form the Case Study of the 2011 Great East Japan Earthquake

Topic: 814B  Special session: Disaster Impact Analysis
Author: Yoshio KAJITANI
Co-Authors: Hirokazu Tatano

CGE (computable general equilibrium) model is one of the promising approaches for estimating economic loss for disaster impact analysis. However, several arrangements of CGE model are required for carrying out realistic loss estimation. For example, stock losses, which are reported after the disaster to capture the direct damages, are utilized for the initial shock of CGE model, but the stock loss cannot capture the functional loss of production facilities due to just displacement of several machineries. This research discusses the ways for modifications on relatively standard CGE models to derive the disaster-specific CGE models from the sensitivity analysis of the real disaster.

## Bridging Input-Output Analysis and Computable General Equilibrium modeling for Consequential LCA: Rectangular Choice-of-Technology model with price-elastic demand

Topic: 516C Special session: Exploring the Interface between IOA and CGE
Author: Arne KÄTELHÖN
Co-Authors: Matthias LAMPE, Björn BAHL, André BARDOW, Sangwon SUH

Input-Output Analysis (IOA) and Computable General Equilibrium (CGE) models are increasingly used in Consequential Life Cycle Assessment (CLCA). IOA expands the system boundaries, while CGE models integrate market feedback mechanisms in CLCA. Even though the benefits of both models are highly complementary, an integrated modeling approach allowing the joint application of IOA and CGE models in CLCA is still missing.

In this work, we propose a new modeling approach, which aims to bridge IOA, CGE, and CLCA, building upon the Rectangular-Choice-of-Technology (RCOT) model.[1] We extend the RCOT model to incorporate physical engineering-level data and price-elastic demand using mixed-integer nonlinear programming. The resulting RCOT model with price-elastic demand allows us to simultaneously determine the supply and demand in multiple markets. In a case study on rice production, we demonstrate that the proposed approach captures changes in complex production technology mixes as well as the expected environmental impacts in response to the introduction of a new climate policy at a high level of granularity.

Reference:
[1] Duchin, F.; Levine, S. H. Sectors May Use Multiple Technologies Simultaneously: The Rectangular Choice-of-Technology Model with Binding Factor Constraints. Econ. Systems Res. 2011, 23 (3), 281-302; DOI 10.1080/09535314.2011.571238.

## TPP Agreement and its Implication on Pakistan Economy- A CGE Approach

Topic: 514X Special session: Economic Implications of Transpacific Partnership Agreement (TPP)
Author: Muhammad Aamir KHAN
Co-Authors: Kakali MUKHOPADHYAY, Naseeb ZADA

The Trans-Pacific Partnership (TPP) is one of the recently negotiated multilateral free trade agreement which aims to establish a free-trade agreement between the 12 economies that lie on both sides of the Pacific. The agreement was signed in 2005 among four economies (Brunei, Chile, New Zealand and Singapore) and came into force in 2006. In 2008, five other economies (Australia, Malaysia, Peru, United States and Vietnam) started negotiation to join the TPP negotiation. The proposed Trans-Pacific Partnership negotiation was further extended, and currently, it includes 12 member economies including Japan. However, the formation and implementation of this proposed partnership is a valid threat to other Asian economies particularly for India, China, and Pakistan. They are excluded from this ongoing trade negotiation. Many scholars have cast doubt on the US participation with the TPP, who argue that the most logical objective of the TPP is to contain and counter the rise and power of China in the Asia-Pacific region.
On the other hand, Pakistan will likely to suffer from this agreement due to trade diversion of textile and apparels in favor of the TPP members under the ‘yarn forward rule’ according to which, it is obligatory for the TPP member economies to import all the components of

manufactured products from other TPP member economies. However, the import of these components particularly the raw material for textiles and apparel from other economies and the traditional suppliers like Pakistan and India will face full duties, and so the implementation of the TPP will adversely affect the global supply chain of textile and apparels. This study evaluates the likely impacts of the Trans-Pacific Partnership (TPP) on the regional trade flows and other macroeconomic aggregates of Pakistan. The study uses the latest version of GTAP (version 9) with the aggregation of regions and commodity sectors into 20 regions and 45 sectors. The current study is based on two alternative experiments. The first experiment considers TPP without Pakistan. The second experiment includes the extended simulation with the assumption that Pakistan is part of the Trans-Pacific Partnership.
The preliminary results reveal a net loss of Pakistan in terms of real investment and imports under the first experiment (TPP without Pakistan) while gaining under the second experiment. On the other hand, an increase in exports is noticed under both the experiments. However, the increase in real exports is higher under the second experiment (TPP with Pakistan) which is 3395 million US dollars (11%) as compared to the first experiment (TPP without Pakistan) which is 369 million US dollars (1.19 %), indicating that Pakistan's participation in the Trans-Pacific Partnership will boost trade flows. On the other hand, Pakistan faces a reduction in real GDP (47 million US $) under the first simulation and increase (314 US million $) under the second simulation. Pakistan also gains regarding terms of trade (0.78) in case of first exercise. Most of other member economies of TPP gain in terms of GDP, exports, imports and industrial outputs under both the scenarios. However, meaningful improvement is observed under the second simulation (TPP with Pakistan) over the first simulation, indicating that Pakistan's proposed entry into TPP will yield region –wide gains. This study suggests that the government of Pakistan should negotiate with the TPP members to participate in the TPP agreement.

## Impact of Proposed Energy Vision 2025 of Pakistan

Topic: 714Y Special session: Economic and Environmental Impacts of Renewable Energy Targets in Asia
Author: Muhammad Aamir KHAN
Co-Authors: Kakali MUKHOPADHYAY

The recently unveiled Pakistan Vision 2025 aims at ensuring continuous access to affordable and clean energy for all sections of the population. To achieve this objective the ten goals are identified which mainly focused on Hydropower projects, nuclear power generation plants, overcome transmission and distribution losses and Introduce institutional reform and strengthen regulatory frameworks to improve transparency and efficiency.

The current shortfall in supply of energy has resulted in a massive negative impact both on societal as well as economic well-being (4-7% loss to the country's GDP). The installed power generation capacity at the end of 2012-13 was 19,560MW, of which Thermal (65 percent), hydroelectric (33 percent) and Nuclear (2.4 percent). The annual per capita electricity consumption in Pakistan is around 320kwh and this only caters for 60 percent of the population. Forty percent of Pakistanis still have no access to electricity. The single renewable energy resource that Pakistan possesses in abundance is hydropower. The hydroelectric power is the cheapest, cleanest and indigenous form of energy. Pakistan is capable of generating 50,000 MW of hydroelectricity, but only about 6,595 MW has been developed for the last 50 years. Pakistan is facing the serious energy shortfall. There is a list of the new projects being implemented or to be launched by WAPDA (Pakistan Water and Power Development Authority). These hydropower projects include 15 very large projects including Bhasha (4,500MW), Dasu (4,320MW), Bunji

(7,100MW), Pattan (2,800MW), Thakot (2,800MW) and others. There are some additional small projects ranges between 100 MW to 500MW. Pakistan has 65,000 megawatts of identified projects and 100,000MW potential. According to an authoritative research, if Pakistan is to develop economically and raise living standards, 50,000MW should be added in the next 15 years. AS we know that energy is vital for economic development of a nation.
Pakistan is one of those countries in which there are massive Transmission and distribution (T&D) losses which is termed as an integral part of the power system. T&D losses due to technical issues and electricity theft pose a very serious challenge. T&D losses in Pakistan are over 25%. According to figures given by World Bank, Electric power transmission and distribution losses (kWh) in Pakistan which include losses in transmission between sources of supply and points of distribution and in the distribution to consumers, including pilferage as last measured were 16115000000 (KWH) in 2011. In Monetary terms, the combined losses exceeded from Rs 31 billion in 2013-14 to Rs 52.6bn in 2014-15. Recently, Pakistan's government has also planned to set up a mega nuclear power plant with power generation capacity of 2,000 megawatts.
Given this new initiative towards energy vision 2025, the current study estimates the impact of additional power generation on the economy using a Global Computable general equilibrium (CGE) framework. Further, it calculates the amount of GHG reductions from renewable sources compared to traditional energy sources. It applies the GTAP database of version 9. The advantage of this new GTAP power database 9.0 contains disaggregated electricity sector such as transmission and distribution (T&D), nuclear, coal, gas, oil, hydroelectric, wind, solar, and other power technologies. Gas, oil, and hydroelectric power are further differentiated by load type: base and peak. Preliminary results show that an increase in industrial output, gross domestic product (GDP), and employment as a consequence of the additional production of renewable energy. It also contributes to nation's GHG emission reduction target.

## Towards a Unified Economic Theory: A Classical-Keynesian GE Model

Topic: 714B  Methodological Aspects of IO Analysis (2)
Author: Atef KHELIFI

The paper presents a judicious way to unify main conceptual assumptions of the Neo-Ricardian, Keynesian and Neo-Classical economic theories within a same model. Although there might be several ways to motivate the development of such a synthesis, emphases in that paper are laid on the importance to micro-found the dynamics of the Leontief input-output system, and on the necessity to formulate a general equilibrium adjustment process during which, production, trade and consumption necessarily occur.

For instance, aggregate GE models widely used in the macroeconomic profession, have all the particularity of assuming (implicitly) a continuous equality between supply and demand for each consumption and capital good, by considering disequilibrium situations as short run phenomenon rapidly resolved by the market clearing process. It is therefore important to remind that such a simplifying assumption is not appropriate in presence of perfect complement commodities, and that a real multi-sector economy may not be characterized by only gross substitute factors and goods.
First, it is well known that the short run market clearing dynamics represented by the 'tâtonment' process where no transactions occur out of equilibrium, has been shown by Scarf (1960) to be unstable under some examples of perfect complementarity. Second, and independently from this problem, it is clear that in a Leontief input-output model involving technologies with fixed proportions of capital inputs, any set of production factors in the economy cannot be fully

employed regardless of price levels. Starting from an exogenous set of endowments means starting presumably from out of equilibrium, in which case input quantities should necessarily adjust to reach a GE position, or in other words, capital accumulation, production, trade and consumption should necessarily occur during the market clearing process (i.e., outside equilibrium.)

In this paper, we propose a more general macroeconomic structure that allows to account for such 'mixed' dynamics. We then use this framework to analyze the important question of potential obstacles preventing from ‘full-employment’ of labor resources. The analysis shows clearly that persistent unemployment results essentially from a coordination failure, and a lack of information about consumption preferences and production technologies. Abstracting indeed from labor market rigidities by assuming for example perfectly flexible wages, appears to be insufficient for the economy to reach a ‘full-employment’ equilibrium. Based on this analysis, a policy suggestion of creating “growth stimulating labor contracts” (GSLC) is finally presented.

JEL Codes: D57, D58, E10, J41
Keywords: Input-Output Model; General Equilibrium; Leontief Model; Equilibrium Adjustment Dynamics; Disequilibrium Theory; Unemployment

## Contribution of Fiscal and Financial Options of Infrastructure Development on Income Distribution and Growth in Indonesia: an Application of Financial CGE Model

Topic: 716C Special session: Development of CGE Models for Transportation Policies
Author: Euijune KIM
Co-Authors: Yasir N. SAMUDRO

We develop a Financial Computable General Equilibrium Model (FCGE) model of 2007 that can analyze the economic impacts of the infrastructure investment projects and their financing options on growth and distribution in Indonesia economy. The FCGE model integrates a real economy with a financial one within the unified economic system, and can trace out the flows of financial and real resources among economic agents. The model is designed to analyze the economic effects of fiscal policies such as the transportation investment expenditures and their procurement approaches on economic growth and distribution among socio-economic classes, linking the investment expenditures with specific financial resource. The model has eight economic institutions, and the portfolio choice for financial instruments is disaggregated into real wealth, government bond, and composite financial assets including private bonds, equity, and deposits. It is possible to estimate growth and distributional effects of each project based on the financing method over the construction and operation periods if the information on the investment expenditures, the construction location and the accessibility of the project are injected into the FCGE model. The simulations on the Indonesian transportation projects find that the government financing with tax revenues could generate higher effects on GDP than other financing methods.

## Cost Structure Comparison of Korea and Japan using Input-Output Tables

Topic: 714A  Special session: Competitive and Complementary Economic Relationships between Korea and Japan
Author: Hyok Jung KIM
Co-Authors: Jinmyon LEE

Economic structure of Korea and Japan share common characteristics. The economic structures of both countries heavily depends on the export competitiveness of manufacturing products such as automobiles, and electric devices. However, there are subtle differences in the cost structure of the manufacturing sectors between two countries. Since Japan has isolated overseas production processes horizontally while Korea distributed production process vertically worldwide, the connection of the Korean economy with foreign inputs is more stronger which implies higher impact on Korean economy than Japanese economy when external economic conditions change. In this context, we use inter-country input-output tables, and compare the cost structure of Korea and Japan industries with special focus on their linkages with other countries. Not only comparing the total anticipated impact of changes in external economic conditions, we also compare the difference in major countries that contributes to changes in production cost in the case of both Korea and Japan. Also, we investigate the third country participation in the production process, and compare the relative sizes, and major countries that induce third country effect.

## Inter-industry Analysis in Flow of funds Accounts: Policy Evaluations and Computational Simulations

Topic: 711A  Special session: Flow of Funds Data and its Applications (1)
Author: Jiyoung KIM
Co-Authors: Takuto SAKAMOTO

This paper aims to analyze inter-industries from the viewpoint of the flow-of-funds accounts and evaluate the effectiveness of monetary policy, including a unique computer simulation. The flow-of-funds accounts show the interrelations between all institutional sectors for each nation, to include oversea sectors, in a systematic and coherent way. It adopts a quadruple-entry system which was proposed by Copeland (1952), that each transaction is recorded with a double entry. In this analysis, we will adopt the input-output analysis method devised by Tsujimura and Mizoshita (2003) to the flow-of-funds accounts. Applying the input-output analysis method into Asset-Liability matrix (ALM) derived from the flow-of-funds accounts, the financial transactions table of institutional sector-by-institutional sector is obtained. Moreover, it is possible to calculate the induced effects of monetary operations by application of Leontief inverse.
However, it is not easy to make a linkage between the input-output table and flow-of-funds accounts. The input-output table, which demonstrates production in the real economy, is composed of hundreds of industries, for examples, in Japan and Korea. On the other hand, only two kinds of institutional sectors, the data of non-financial public corporations and non-financial private corporations, are announced for the flow-of-funds accounts. Based on the combined use of balance sheets and income statements of various industries, the financial transactions table which is subdivided into various inter-industries is constructed. Using this expanded financial transactions table, we report the results of the monetary policy evaluations. Furthermore, computational method approach is examined for this analysis. The policy authorities are required to choose financial instruments in liabilities and assets simultaneously, when they implement any type of monetary policy. This study offers a unique computational approach to analyze and

simulate the optimal monetary policy.

## Generalized Global Unit Structures and Global Production/Value-added Networks: A World Input Output and Social Network Approach

Topic: 809W  Methodological Aspects of MRIO Analysis
Author: Tae-jin KIM
Co-Authors: Jungu KANG, Seung-jin SHIM

In this paper we analyze Global Production and Global Value-added Networks. For this purpose, we introduce a reliable approach to applying Social Network Analysis (SNA) to an input-output framework. Our approach involves two essential steps. In the first step, we derive global unit structures in different ways, namely by gross output and value-added, from a World Input-Output Table (WIOT) in the World Input Output Database (WIOD). In the second step, we investigate characteristics of Global Production Networks (GPNs) and Global Value-added Networks (GVNs) based on global unit structures, which differ from the existing GPNs and Global Value Chains (GVCs).
The unit structure approach in a single-region input-output (SRIO) model was developed by Ozaki (1980). In our experiment, we try to formulate the general type of the unit structure model and expand Ozaki’s unit structure model into a global multi-region input-output (GMRIO) unit structure model. A global unit structure based on gross output (GUGO) is a square matrix that shows the required global direct and indirect intermediate transactions in order to produce one unit of final demand of a specific industry. We analyze a Global Production Network (GPN) in the GUGO.
A limitation in Ozaki’s unit structure model is the problem of double counting because his derivation method of unit structures is only based on gross output. In order to overcome a limitation of Ozaki’s model, we propose a new approach: the derivation method of global unit structures based on value-added. An economic interpretation of the global unit structure in value-added (GUVA) is value-added impacts of global direct and indirect intermediate products to produce one unit of final demand of a certain industry. We investigate a Global Value-added Network (GVN) from our new approach to the GUVA.
GUGOs and GUVAs are well-suited for Network Analysis. There are two reasons for this. Firstly, GUGOs and GUVAs are Complete Networks. Secondly, GUGOs and GUVAs are derived from WIOT for the period from 1995 to 2011. Thus, cross-sectional and time-series international comparisons of network indices based on GUGOs and GUVAs at the country-industry level are possible. Therefore, our approach provides reliable and comparable results of network analysis based on the global unit structure framework. From the WIOD, we divide the 41 countries into 7 regions: Korea, the United States, China, Japan, EU, BRIIAT (Brazil, Russia, India, Indonesia, Australia, and Turkey) and ROW (the Rest of the World). In our study we focus our attention on key industries, such as Transport Equipment, Electrical and Optical Equipment, that can represent characteristics of GPNs and GVNs well. And we use a set of measures of network indices from SNA to identify GPNs and GVNs.

## The China-Korea Free Trade Agreement and Its Economic Impact in Explicit Consideration of Foreign Direct Investment: A CGE Approach

Topic: 714C  Special session: Computable General Equilibrium Modeling for Policy Impact Analysis
Author: Jong H. KO

The objective of this study is to conduct a quantitative assessment of the potential economic effects of the Korea-China FTA that came into effect on 20 December 2015 using the GTAP-FDI model that explicitly takes into account foreign direct investment (FDI) and foreign commercial presence differentiated by the country of location and ownership. In analyzing the potential economic effects of an FTA, the role of FDI becomes increasingly more important. FDI is associated with the international mobility of capital and FDI implies firms operating across national borders. Modeling FDI in a CGE framework should cover both of these aspects. This study is based on the concessions of trade liberalization agreed between Korea and China. In addition to trade liberalization through tariff reductions, ad valorem tax equivalents of FDI restrictions on FDI and foreign affiliates sales, which are calculated by multiplying FDI restrictiveness index with the elasticity of FDI with respect to the FDI restrictiveness index and the elasticity of foreign affiliates sales with respect to the FDI restrictiveness index, respectively, are used for policy scenarios of FDI liberalization. The impacts of the China-Korea FTA include macroeconomic effects such as real GDP, welfare, total exports, total imports, trade balance and terms of trade of the two countries as well as microeconomic effects such as production of domestic firms and foreign firms by sector, employment of domestic firms and foreign firms by sector, and exports and imports of domestic firms and foreign firms by sector.

## Incorporating behavioral aspects into input-output model

Topic: 516C  Special session: Exploring the Interface between IOA and CGE
Author: Yasushi KONDO
Co-Authors: Sangwon SUH

One of the main differences of Computable General Equilibrium (CGE) models as compared to input-output models is that CGE models incorporate behavioral principles such as cost minimization or utility maximization. In the Rectangular Choice of Technology (RCOT) model, such behavioral principles of producers are incorporated into an input-output model. However, RCOT model, as its original form, does not consider behavioral principles of consumers or households. In this presentation, we explore a way to incorporate behavioral aspects of consumers by introducing an Agent-Based Model (ABM) that determines the composition and scale of consumption, which is then fed into RCOT model that determines the price and technology mix of producers. We will present the structure of a toy model and its results to demonstrate that the combined RCOT-ABM approach successfully integrates behavior of both producers and consumers. We will discuss the implications of this combined model in the broader context of the discussion on the interface between CGE and input-output models.

## The impact of real effective exchange rate of RMB on China's export and value-added export

Topic: 814Z International Trade (3)
Author: Yishu KONG
Co-Authors: Xinru LI

As China’s international trade surplus growth continuously, China is now under great international pressure to let its currency appreciate. How does China’s export change if RMB appreciate? Based on the time series data from 1990 to 2015, the impact of real effective exchange rate of RMB on China’s export was analyzed, using econometric analysis methods like regression model. And its influence on value-added export was further analyzed utilizing Chinese DPN table of the year 2010, detailed export structure in 2013 and export data in 2015. The result showed that every 1% appreciation of RMB would decrease China’s value-added export by 0.52% and 0.72%, before and after 2005 respectively; REER becomes even more important to China’s export after the establishment of new floating exchange rate system; China’s export will decrease 16.45 billion dollars and finally the 1% increase of REER will decrease domestic value added by 11.28 billion dollars, based on export data in 2015.

Keywords: the RMB exchange rate, export, value added, DPN table

## Taxing CO2 in production and consumption in Europe: The socio-economic and environmental impact of three tax reform options

Topic: 714X Special session: Taxation
Author: Kurt KRATENA
Co-Authors: Mark Wolfgang Sommer

Environmental tax reform and CO2 pricing policies in one world region in the form of unilateral climate policy lead to problems of price competitiveness of the manufacturers in this region and to 'carbon leakage', i.e. relocation of energy and emission intensive production to the other world regions without climate policy, thereby causing possibly higher emissions per output globally and harming domestic industry. Large part of the literature consists of CGE model simulations on this channel of carbon leakage (for example: Burniaux, Oliveira Martin, 2000, Paltsev, 2000). In order to avoid the negative impacts on price competitiveness, several studies have analysed the potential of border tax adjustments with ambiguous results as far as the welfare impact is concerned (Lockwood and Whalley, 2008 and Dong and Whalley, 2009). Recently, as an alternative to border tax adjustment, the idea of taxing the carbon footprint has been discussed (Eichner and Pethig, 2015, or McAusland and Najjar, 2015).
This paper compares the traditional environmental tax reform for CO2 emissions with two alternative taxation schemes: (i) taxing CO2 emissions embodied in consumption instead of domestic production and (ii) combining traditional environmental tax reform with border tax adjustments, based on CO2 emissions embodied in consumption. All three taxation schemes are introduced in the framework of a unilateral policy of the EU27. The embodied emissions in (ii) and (iii) are taxed independently of their origin. The CO2 tax rates applied are identical and revenues of the new CO2 tax are in both cases recycled via lower social security contributions of employers as well as of employees. The analysis is done with a DYNK (Dynamic New Keynesian) model covering 59 industries and five groups of household income for the EU27. The domestically (within the EU 27) embodied CO2 emissions are calculated by unitary shocks for each commodity

in the DYNK model. The emissions embodied in imports from Non-EU 27 as well as the resulting carbon leakage from an EU 27 perspective are calculated using a simple MRIO (Multi-Regional Input-Output) model. The results show the different macroeconomic results, driven by the different impact of the taxation schemes on price competitiveness of EU 27 firms. These differences in trade effects also drive the significant differences in leakage. The three taxation schemes are also regressive for household incomes, but in a very different magnitude.

## The Carbon Footprint of European Households and Income Distribution

Topic: 516F  Environmental IO Modelling (2)
Author: Kurt KRATENA

This paper calculates the CO2 footprint of private consumption in the EU27 by five groups of household income. The footprint calculations are carried out with a DYNK (Dynamic New Keynesian) model covering 59 industries and five groups of household income for the EU27. This model is used to quantify the domestically (within the EU 27) embodied CO2 emissions. The emissions embodied in imports from Non-EU 27 are calculated using a simple MRIO (Multi-Regional Input-Output) model. The footprint is calculated separately for the consumption vector of each of the five income groups. The results are partially influenced by different absolute levels of consumption and partially by different consumption structures. These differences are highlighted in a simple decomposition exercise.

## Impact of European integration on employment and value added creation

Topic: 711X  Employment Analysis (1)
Author: Jozef KUBALA
Co-Authors: Martin HUDCOVSKY

Trade without taxes and quotas and free mobility of production factors resulted in very tight economic relations between member countries of the EU in the beginning of 21st century. Since economic integration has become relevant topic, it is more than desirable to understand its consequences. In the paper, we are focusing on the enlargement of the European Union which took place in 2004 and examine which driving forces were behind the changes in employment and value added creation in chosen member countries of the European Union over the years 1995-2009. Changes are studied in chosen EU 15 (former members) and also in EU 10 (joined to the EU in 2004) countries. We utilize World Input-output tables to decompose value added and total hours worked by person engaged changes into various determinants (changes in technology, changes in the amount and structure of final demand, changes in sectoral value added and hours worked coefficient) and determine which factors were most important driving forces in value added and hour worked changes before and after the enlargement of the EU in 2004.

## Decomposition of gross exports into value-added exports at the bilateral level: an alternative gross exports accounting system

Topic: 516D Trade in Value-added
Author: Masaaki KUBONIWA

In this paper we present an alternative accounting system of gross exports at the bilateral level in place of Koopman et al. (2014). First, we re-define bilateral value-added exports by elements of the value-added ratios, international Leontief inverse, and gross exports/imports based on Trefler and Zhu (2010). Second, we prove that our definition of bilateral value-added exports is mathematically equivalent to Johnson and Noguera (2012)'s value-added exports defined by elements of the value-added ratios, international Leontief inverse, and destination country's final demand. Third, however, we demonstrate that we can bilaterally trace value-added and double counting in gross exports in a better manner if employing our definition of value-added exports in place of Johnson and Noguera's definition. In particular, for a bilateral trade system with more than three countries we can clearly witness two parts of return-home and no-return in the foreign content of gross exports. We also provide empirical results or numerical examples for two-country (China and the rest of the world) and three-country (China, USA and the rest of the world), using aggregated World Input-Output Data, in order to enhance our alternative gross exports accounting system.

## The Creation of Policy Options of Science, Technology and Innovation Policy

Topic: 514A Special session: Science for Re-designing Science, Technology and Innovation (SciREX) Policy
Author: Masahiro KURODA
Co-Authors: YASUSHI HARA, Michael C. HUANG

The 21st century marks the prosperity of internet of things (IoT) in cyber physical systems with the stream of technology change that drastically reshaped the social economy structure. The study aims to develop a recursive dynamic model of science technology and innovation policy for analyzing social economic impact and assessment on the science for policies. By reviewing the economic impact through examining several alternative policy options on the manufacturing sectors with IoT implementation for its information allocation and processioning to accelerate its productivity. The data used in the model were sourced from Japan's input-output table with expansion of the tangible and non-tangible capital investment by considering long/short run block, labor market modeling, value-added and wage determinant, government balance sheet, foreign and the final demand block.
The study interpreted interconnection of exogenous technology scenarios in comparison with the policy options with the baseline of business as usual (BAU) to derive the impact in the general interdependency of economy constituted the multi-sectoral general equilibrium economic model. The model expected to shed lights on implication of total factor productivity (TFP) for its process change on the demand side while the productivity improvement in information provision service sector that enlarges the platform business, assisting manufacturing sectors to create new market and variate the international production networking structure. Such business platform is indispensable for utilizing the cross-sectoral information technology whereas these fundamental factors based on information and system technology of robotic artificial intelligence will construct a new relationship of human kind and machine. The study demonstrating policy options by introducing different level of the processing efficiency index (P-index) in the activity divisions of

marketing, planning, R&D, procurement, operation and sales, conservative, the deviations of economic variables in production process were examined.
The simulation results showed the change on employment and production division along with the IoT and ICT advancement of its short/long-run effect. For manufacturing sector, the efficiency improvement would increase the production, public, private R&D investment and consolidate the knowledge stock for the expansion of knowledge infrastructure that rose TFP. Also, the information management could benefit from outsourcing and externalization while the cross-sectional platform of information management may thus be established. Finally, the human resource and higher level professional education revealed an increase especially in information related, service and R&D division in private sector. The industrial evolution would increase the gap of knowledge that causes technological unemployment remains a concern, the analytical framework in the study is expected to provide evidence-based approach to tackle the critical issue.

## The Past, the Present and the Future of Korean Input-Output Tables

Topic: 514D  Special session: Korean Input-Output Tables: Practical Viewpoints
Author: TaeHyun Kwon

This paper discusses the history and experience in compiling Korean Input-Output Tables since 1960.  In Korea, Input-Output table, including National Accounts like GDP, BOP, is compiled by Bank of Korea, which is Korean central bank. Korean Input-Output tables have a variety of the history of changes. The first version is 1960 input-output tables compiled by the request of government to establish the 5 Year's Planning of Economic Development at that time. Bank of Korea has compiled total 31 input-output tables since 1960 Input-Output table and, especially, has compiled IO tables every year since 2006 Input-Output table. The most recent table is 2013 Input-Output tables, released in 2015. Korean Input-Output tables can be largely sorted by benchmark table and extended table. Benchmark table has been compiled every 5 years, which ends 0 and 5. Of course, there were exceptional cases. 2013 input-output tables, is also the extended table, which benchmark is 2010 input-output table. Korean 2010 Input-Output tables have both symmetric input-output table and SUT. SIOT is commodity by commodity and SUT is commodity by industry. The 2010 SUT is the first official version in Korea, follows the recommendations of the 2008 SNA.

## Structural Decomposition and Shift-Share Analyses: Let the Parallels Converge

Topic: 514B  Structural Decomposition Analysis
Author: Michael L LAHR
Co-Authors: Erik DIETZENBACHER

Intuitively, structural decomposition analysis (SDA) demonstrates strong similarities to shift-share analysis (SSA). Both examine the effects of industry shifts due to growth (or decline) and some sort of difference in industry shares. But SSA works its shares across space while SDA works its shares again across industries via technology change (fabrication effects). Suffice it to say, SDA and SSA are related, and this chapter will formally combine the two disparate strands of literature. In particular, it will show how changes in regional growth differentials can be included into a structural decomposition analysis.

For example. Oosterhaven and Escobedo-Cardeñoso (2011) have demonstrated that regional I-O tables can be forecasted fairly well. One innovation they applied was lagging the “remainder” from the biproportional adjustment technique. This remainder looks remarkably like the “regional component” (also termed the “competitive effect”) in SSA. More recently, Arto and Dietzenbacher (2014) performed what might be termed a “dynamic” SDA to examine the effect of trade changes on the growth of global CO2 emissions. This harkens parallels to dynamic SSA (Thirlwall, 1967; Barf and Prentice, 1988).

Suffice it to say, SDA and SSA are related and this paper formally combines the two disparate strands of literature. In particular, we show how changes in regional growth differentials can be included into an additive structural decomposition analysis. Moreover, the present availability of a large number of input-output table panels appears to enable the detection of even more parallels between the two approaches. Between the formalization of the SSA-SDA relationship and the available I-O data, a wide range of new, policy-relevant empirical applications is possible. We conclude the paper by suggesting several avenues for future research.

## Fragmentation, Global Trade and Domestic Value-Added Ratio

Topic: 516W  Special session: Global Production Networks: Theory and Empirics (2)
Author: Edwin L. LAI
Co-Authors: Han Steffan QI

International fragmentation of production, which refers to the phenomenon that different tasks in the process of producing a good are carried out in different countries, has become widespread. As a result of fragmentation, domestic value-added embedded in the exporting country's gross exports (called domestic value added ratio, DVAR) is often much lower than 100%. Thus, DVAR is an important indicator of fragmentation. In this paper, we develop a multi-country Ricardian model of comparative advantage with international fragmentation of production by modifying the Eaton and Kortum (2002) framework. We show that international fragmentation of the production process has important implications on the global specialization and trade pattern and on the DVAR of countries all over the world. The paper makes a few contributions to the literature. First, it helps us to understand global trade pattern and trade flows through the lens of fragmentation and global value chain. It explains roundabout trade between countries in the global trading system, and predicts the locations of the assembly centers. Second, it explains the stylized facts about DVAR across countries and across sectors. Third, it provides a theory to explain how the DVAR of a country is determined, and then tests the hypotheses that arise thereof. In the empirical work, we make use of the updated data set jointly constructed by the OECD and WTO and released in June 2015 that accounts for trade in value-added (TiVA) among the major economies in the world. We find reasonably strong empirical supports for our theory.

# Climate policy design to preserve the competitiveness of the French industry with hybrid input-output tables

Topic: 514C  CGE/econometric IO Modelling (1)
Author: Gaëlle LE TREUT

While implementation of climate policy is at stake, there are always tensions between countries or agents. Beyond equity issues either at the regional or international scale, globalization drives concerns about unilateral actions. Indeed, issues of competitiveness for energy-intensive and trade-exposed (EITE) sectors and resulting carbon leakage often come up in the debate. To protect these industries and increase the environmental efficiency of a unilateral climate policy, compensation mechanisms or border tax adjustments (BTA) are often considered (Böhringer, Balistreri, and Rutherford 2012). Numerous studies examined the impact of such measures on competitiveness and leakage issues. If there is largely a consensus to say that BTA deals positively with those issues, the level of reduction remains uncertain. Partial equilibrium modelers generally rightly argue that computable general equilibrium (CGE) models embark poor details on EITE sectors, with a high level of aggregation. Some efforts tend to be made in CGE models to demonstrate the relevance of disaggregated EITE sectors; taking into account their heterogeneity changes significantly the impact of a climate policy at the sectoral level (Alexeeva-Talebi et al. 2012; Caron 2012). Nevertheless, the disaggregation is only in value. This paper proposes to embark physical information on energy, steel and cement sectors into the modeling framework. Then, we explore tax arrangements at the country scale of France that can help to reduce the negative aspects of the application of carbon tax through objectives comprising equity, competitiveness for EITE sectors and better environmental efficiency.
We use the IMACLIM-S France "hybrid" CGE model designed for comparative static exercises. It represents an open-French economy, distinguishing four categories of agents (households, businesses, government and "the rest-of-world"). The description of the production system distinguishes the energy sectors, as well as energy-intensive sectors, and a composite remainder of the economy.

The country scale allows proposing an innovative procedure for building hybrid Input-Output matrices including information about energy as well as cement and steel flows, prices and quantities coming from physical statistics, without alteration on this data. All this information is then introduced within a consistent social accounting framework. Standard macroeconomic models are exclusively built on monetary data drawn from national accounts and benchmark quantities are not described in physical units. The need for physical information, such as energy consumption, to carry out energy/economy/environment analysis has led to develop hybrid accounts. All hybridisation procedures follow two basic accounting principles: (i) both the physical and money descriptions must respect conservation principles (the balances of resources and uses, respectively in quantities and values), (ii) physical and money flows are linked by a system of price. However, the method of data hybridisation is not standardized and different procedures may be proposed. In developing hybrid methods for the IMACLIM modelling framework, we follow two main rules: (i) the total size of the economy is preserved, (ii) the data on energy quantities and prices faced by economic agents are reintroduced. The procedure involves three mains steps illustrated on the 2010 French economy, focusing on energy flows, but the same procedure is applied to cement and steel industries in order to isolate those sectors in the initial description.

The critical point of a carbon tax reform is to contain the spread of higher energy costs on production costs, which ultimately affect the purchasing power of households and affect the international competitiveness of firms when reform is unilateral. The combination of a carbon tax with structural policies to support growth (lower social contributions) does not reduce the unequal

effects of taxes. To reconcile equity, competitiveness and environmental issues, it seems essential to combine these policies with specific compensation mechanisms or complementary policies according to household income levels, and to the exposure of energy-intensive sectors to international trade. Thanks to the hybrid sectorial disaggregation described in the latest version of the model, we are now starting a set of experiments in which we consider various revenue-recycling schemes that better preserve altogether economic efficiency, equity and competitiveness. We are also testing an implementation of BTA for extra-Europe importations. Finally, we compare the impacts of those different strategies on various macroeconomic indicators, and through analysis of the corresponding distributive effects on EITE sectors. We can then observe how hybrid data on cement and steel sectors change the policy impacts.

## Key sectors in economic development: a perspective from input-output linkages and cross-sector misallocation

Topic: 714D  Productivity and Efficiency (2)
Author: Julio LEAL

For a typical developing country, this paper shows that once inter-sectoral linkages are taken into account, closing the productivity gap in a number of services gives bigger gains in aggregate productivity than closing it in agriculture or in manufacturing, despite their larger gaps. This is performed in the context of an input-output economy and general equilibrium. Also, the importance of sector-specific distortions that produce cross-sector misallocation is addressed. I compute the effect of the removal of these distortions on aggregate productivity using the input-output model and find that this could increase productivity up to 68%, depending on whether the rents from distortions stay in the economy or not.

I make two main arguments regarding the questions at hand. First, I argue that to determine which sectors make poor countries so unproductive, it matters not only which sectors have the largest productivity gap with respect to the leader, but also the “degree of influence”See Acemoglu et al. (2012). of each sector. This degree of influence is determined by the way each sector is linked to the rest of the economy through input-output relationships. Some sectors play a central role in the input-output network because they are important suppliers of intermediate inputs in the economy, and thus, they have a high degree of influence.

The second argument in the paper is that there exist sector-specific distortions in developing countries that are not directly linked to low productivity at the industry level, but that could be a source of cross-sector misallocation, and thus, have an impact on aggregate productivity. These distortions disrupt the equalization of marginal products across sectors potentially undermining aggregate productivityKeep in mind that sector-specific distortions might simply be the result of firm-level distortions that differ across sectors.. The second goal is to measure the quantitative importance of these distortions on aggregate productivity, and to understand the economic channels through which this occurs.

To achieve these goals, I use a multi-sector model with inter-sectoral linkages based on Long Jr et al. (1987), Acemoglu et al. (2012), and Jones (2011). In the model, there are N  sectors (or industries) that produce different goods. The output of each sector can be used either as consumption or as an intermediate input in the production of the other sectors. This introduces the link between the performance of an individual sector and the performance of the rest. I calibrate this model to Mexico, an important developing country, and perform counterfactuals.

## Water Demand Management and Adaptation to Climate Variability for the Pro-Growth Taiwan Economy

Topic: 714E  Special session: Economic and Environmental Relationship in Asian-Pacific (1)
Author: Huey-Lin LEE

Taiwan is ranked 18th among all countries in terms of water scarcity. It is almost not possible to build extra reservoirs due to the unfavorable geological conditions and increasing protests by environmentalists. Given such water storage constraints, further hydrological pressure imposed by climate change—as the IPCC Fifth Assessment Report and research by local scientists predict of more intensified precipitation and variations between wet/dry seasons—policies focusing on water demand management would be imperative for Taiwan to adapt to future hydrological change and the increasing competition for water between water users in its course of economic development. The prevailing water price in Taiwan is relatively low as compared with other countries. The increasingly water-intensive industry structure—e.g., electronics and petrochemical industries, which are also the biggest GDP contributors—is pushing up water demand in Taiwan. Over the past decade, competition for water resources between agriculture and industrial sectors intensified particularly in the wake of climate-induced disruption of fresh water supply. More intense competition for water resources is foreseeable with the looming climate change. Reflecting such water constraints and competition for water resources between economic agents, we built a computable general equilibrium (CGE) model—which describes sectoral water demand and cost-efficiency interaction, under the exogenously given water supply—to investigate the economy-wide impact of coping strategies, such as raising water price, for Taiwan under potential water supply stress as imposed by climate variability. Our results indicate that raising the currently very low water price to commensurate with the average cost of water supply would cause only minor impact on the economic growth, particularly the key sectors of the economy. This suggests that raising water price will be desirable to attain water efficiency and get water users prepared ahead of time to brace for and to adapt to likely water stress under looming climate variability.

## Balancing Economic and Environmental Goals for Sustainable Development: An Environmentally Extended Input-Output Analysis of India

Topic: 814E  Special session: Economic and Environmental Relationship in Asian-Pacific (2)
Author: Huey-Lin LEE
Co-Authors: Anindita GANDHI

Economic policy in India has predominantly prioritized economic development and national income growth. Discussions around sustainable growth have emerged in recent decades. However, policy measures around environmental accountability has not received due attention in India. The government has recognized the need to reduce harmful emissions and to increase environmental accountability in production and consumption. Yet, actions taken towards this motive remain insufficient given the intensity of environmental degradation and pollution India faces. As of 2011, India ranked fourth in the world in carbon emissions. With the world leaders meeting up for the Paris Climate Summit, India’s stand on the issue is critical. It might be unsettling that India, although a signatory, was not obligated to reduce greenhouse gas emissions under the Kyoto protocol. It was argued that much of the emissions in developing nations like India and China is due to production fuelled by demand from the west. However, despite the cause, the effect has attracted huge attention from activists and academia alike. It is

our view that an economy-wide analysis describing interconnection between demand and production is useful in visualizing the nexus of economic and environmental goals. We employ an environmentally extended Input-Output framework as developed by Leontief (1970) to estimate the changes in production and demand under various pre-specified tolerable levels of carbon emissions, and thus resulted changes in economic growth for India. Our preliminary results show that economic and environmental goals may not be conflicting with each other as long as policies are wisely designed. Our analysis provides insight for policymaking towards sustainable development of the Indian economy.

## The effects of external shocks on the Korean economy : CGE model-based analysis

Topic: 514D  Special session: Korean Input-Output Tables: Practical Viewpoints
Author: Hyeok LEE
Co-Authors: Yong Kyun KIM

Today, economies are vastly interconnected in a global network. An economic shock originating from another economy may have compounding effects in the receiving end. This may be especially more true for a small open economy. Hence the study of how external shocks ripple through her system is of great interest to a small open economy.

By utilizing a Computational General Equilibrium (CGE) model, this paper tries to investigate the systematic effects of external shocks to a small open economy, namely South Korea. In this paper we use the 2013 Input-Output table for South Korea. For the analysis to better reflect the real world economics, we estimate the underlying parameters of the economic system. Our goal of the paper is to trying to trace the path of how external shocks travel through the economic system of a small open economy.

## Estimation of Dynamic Impact of Port Shutdown on Spatial Economies Using CGE Model with a Micro-Simulation Module of Seaport Activities

Topic: 716C  Special session: Development of CGE Models for Transportation Policies
Author: Min-Kyu LEE
Co-Authors: Euijune KIM

The paper estimates spillover effects of port shutdown on spatial economies using a CGE model with a micro-simulation module of seaport activities. Schematic structure of causality between the port shutdown and commodity flows and production are derived from interviews and foreign port shutdown cases in terms of risk-based inter-industrial analysis. The model is applied to assess the effectiveness of policy instruments to minimize the economic negative effects of X-event on the regional economic growth, estimating changes in the transportation and logistics costs and the outputs. The simulation results are expected to develop a comprehensive port risk management system and a framework on protection of national infrastructure safety plans.

## The Valuation of Transactions and the Treatment of Scrap in Korean Input-Output Tables

Topic: 514D  Special session: Korean Input-Output Tables: Practical Viewpoints
Author: Moonhee LEE

The valuation method of Korean 2010 benchmark input-output table is valuation at basic prices. So each transaction value does not include the net taxes on products, and a row for the net taxes on products is added to total intermediate inputs for industries and final demands. And the value of scrap generated in production or final demands is subtracted from total intermediate inputs and final demands, not from each transaction. These methods make some difficulties in input-output analysis.

This paper describes the current methods of valuation and treatment of scrap in Korean I-O tables and shows that these methods are not proper for some analytical purposes. And we compare them with other methods such as valuation at producers' prices and the negative input method for scrap. These alternatives can be solutions for the problem.

## The impact of services liberalization on GVC participation

Topic: 516X  Regional Trade Agreement and Trade Governance
Author: Woori LEE

This paper examines the role that services liberalization plays in allowing a nation to participate in manufacturing and services global value chains (GVCs). Using variations in measured services restrictiveness, we empirically test whether trade liberalization in services stimulates production fragmentation of both goods and services as existing theoretical literature suggests. When it comes to services GVCs, the link is quite direct. When it comes to manufacturing GVCs, the presence of local or imported services can facilitate GVC participation. This is because trade in goods almost always requires direct and indirect inputs from several services industries that makes international transactions easier. Going beyond the role of trade services such as transportation and insurance in stimulating trade, which has been more recognized in the literature, we consider a wider range of services that support a broader division of labor associated with the unbundling of production.

Measures of services trade restrictiveness are notably less developed than those for trade in goods, but some recent work has developed indicators of services liberalization. To examine the impact of services trade restrictiveness in GVC participation, we use the OECD Services Trade Restrictiveness Index (STRI) which measures the level of services trade restrictiveness in 18 sectors for 40 countries. As the dependent variable, we use indicators of GVC participation constructed from the OECD Trade in Value Added (TiVA) database which provides data for 57 economies, broken down by 18 industries.

This paper will contribute to the newly growing literature on the role of services trade in the GVC discussion. It expands on some existing work that studies the impact of services liberalization on downstream manufacturing performance.

## Compilation and Analysis of Korean SME's Input-Output Table

Topic: 514D Special session: Korean Input-Output Tables: Practical Viewpoints
Author: Youngho LEE

This study aims to compile applicable Korean SME's IO and to perform analysis based on its input-output structure for 2010 and 2012. In the procedure of these SME's IO, some major considerations are industry classifications, compilation process and statistical data base.

Industry classifications of this research is primarily based on classification system of the Bank of Korea, but focused on industries where dividing large enterprises and SMEs has implication. Aggregating basic 384 sectors, we handled 70 industries(two primary industries, 39 manufacturing, 4 SOC sectors, and 25 service sectors) and distinguished large enterprises and SMEs.

Our research team made data base for the two point of time based on Economy census, Survey on Sales and Buying of SMEs for 2010 and Industrial statistics such as Mining & Manufacturing survey, Service Industry Survey, Census on Establishments and so on for 2012 because economy census was not conducted by STATISTICS KOREA.

Compilation of SMEs IO is basically composed of six steps. First, we build a product-by-industry table by using the data base. Second, we adjust input side by compiling commodity-output table of SMEs after reorganizing the data base from establishment to firm level. Third, we adjust output side by using product-by-industry table. Fourth, we adjust final demand part by using export and import share of SMEs data in Korean trade statistics. Fifth, we make transactions table that depicts input-output structure of large enterprises and SMEs by balancing each sector. Lastly, we make import transactions table by applying import coefficients of national IO table by the Bank of Korea. Also, we showed that analysis using input coefficients of SMEs IO table is economically meaningful by testing HS conditions.

After these Korean SME's IO, our research team carry out analysis for the economic impact for indirect export of SME and public supply system oriented to SME. First, a lot of SMEs have contributions to Korea exports indirectly as providers of intermediary good to large company. However, theirs contribution is not apparent on the official trade data. This study shows the SME's indirect contribution in terms of value-added and labor. The contribution of SMEs is greater than the surface from trade data. Second, Korean government have managed on the public supply system to support SMEs by making any public institutions and offices purchase good of SME. Using 2010 and 2012 Korean SME's IO, the policy of public supply is analyzed. According to the results, the public supply policy has have an important role to vitalize and grow up SMEs.

## Compilation and Analysis of Input-Output Table for Korean Kimchi and its Related Commodities

Topic: 814C Special session:Economic Impacts of Specific Foods: Kimchi, Tsukemono, Tomato
Author: Youngho LEE

Kimchi represents the true spirit of Korea and is considered to be one of the healthiest foods in the world. However, without an adequate analysis tool, there have been limitations to evaluating how much important Kimchi industry is in the Korean economy and estimating economic impact of the industry. Adding to that, more reliable analysis of Kimchi industry is needed for better policy-making, support and estimation of the industry.

This research is aimed at understanding the reality of the Kimchi industry with maintaining objectivity and developing analysis tool to analyze the correlation with related industries. The development of an Kimchi industry-oriented IO table will allow us to grasp how Kimchi industry is

correlated with other industries in the economy as a whole and how much the industry is important based on the input-output structure.
The research purpose is drawing up an Kimchi industry oriented-IO table with separating Kimchi from other related items and making Kimchi industry an independent one. It will utilize Economy Census, Mining & Manufacturing Survey and Import and Export data from Korea Customs to organize basic statistical DB. Then we will conduct estimation and separation of total output, value-added and final demand of the Kimchi industry. For the estimation of endogenous part, survey on the actual condition of Kimchi production companies and Kimchi refrigerator manufacturers will be made to precisely analyze input and output side of the industry. Based on the result, we will estimate endogenous part.
With the Kimchi industry oriented-IO table, a study on economic impact of the industry will be conducted using production inducement coefficient, value-added inducement coefficient and labor inducement coefficient.

## General Equilibrium Analysis of Energy Development Scenarios: the Case of Lithuania

Topic: 514C CGE/econometric IO Modelling (1)
Author: Vidas LEKAVICIUS

The aim of the research is the evaluation of overall economic impacts caused by the choice of an energy development scenario in Lithuanian case.
The energy sector development scenarios are considered as exogenously described energy pathways that cause responses from the remaining economy. All these responses, including inter-sectorial linkages and impacts of changes in relative prices, are evaluated using especially created dynamic computable general equilibrium (CGE) model, which covers four energy products (electricity, district heat, natural gas, and biomass), 19 other commodities and economic activities; sectors of corporations, government, and households; international trade with the rest of the world. An aggregated reflection of tax system, other transactions as well as explicit representation of the energy infrastructure is also incorporated into the model. This allows assessing changes in the energy sector in the context of entire economy, considering energy sector as an integral part of the economy, which affects other types of economic activity and institutional sectors, both due to changes in supply of energy resources, and as a result of changes in demand for other commodities and production factors, impact on the fixed capital formation, and other issues caused by energy development. The net impacts of a particular scenario are revealed by comparison of results of selected scenario with results from other scenarios.
Various data sources were used in the analysis. Basic information about the energy scenarios (capacities installed, energy produced, fixed and variable operation and maintenance cost, etc.) was obtained from bottom-up energy planning model and complemented by the detailed description of energy technologies in terms of commodities and production factors used and other properties. The core data for economic modelling is social accounting matrix (SAM), which has been created using official data from Eurostat and Statistics Lithuania, which was adjusted taking into account the physical energy flows reported in Fuel and Energy Balances. The most of parameters that are employed in the model are calibrated directly from SAM or collected from external data sources. The shares of minimum necessary purchase of commodities have been estimated econometrically from the dataset of Household Budget Survey which is provided by Statistics Lithuania. Following the usual praxis, elasticity parameters for constant elasticity functions have been taken from scientific literature.
The novelty of the present research can be characterised not only by the results obtained

(various economic indicators are calculated and the most influential factors are determined), but also by several methodological innovations. First of all, new modelling solutions were developed for the integration (“soft-linking”) detailed bottom-up energy modelling data into a CGE model. Second, the analysis covers not only electricity, but also three other energy products that are most relevant in Lithuanian context. Finally, especial attention is devoted to the modelling of energy infrastructure. The energy infrastructure and its cost allocation among consumers is in the CGE framework is modelled explicitly. This modelling approach reflects the real world situation when energy prices for consumer groups are different as a result of either different type and amount of infrastructure used (e. g., electricity from transmission or distribution networks) or due to disparities in market regulation that allows differentiation of infrastructure cost attributed to the consumers.

## Research on Division of Labor of China’s Domestic Value Chain from the Perspective of Global Value Chain

Topic: 809A  Regional IO Modelling (1)
Author: Shantong LI
Co-Authors: Jianwu HE

Chinese domestic value chain has been integrated higher and higher with the global value chain, and the economic tie between different domestic regions and their relations with abroad is becoming more and more close in accompanying the development of globalization of the economy and the integration of China’s domestic regions. Therefore, it is necessary to recognize the transition of Chinese economy and regional economy from the perspective of global value chain. This research will collect and prepare the I/0 table of China’s thirty provinces (including autonomous regions), construct domestic inter-provincial I/o data base. A global I/o model with embedded Chinese interprovincial I/o module will be constructed based upon above base in combination also with WIDO which can analyze China’s domestic value chain from the perspective of global value chain. This model can also be applied to analyze the division of labor of participation of China’s different domestic regions to the global economy as well as domestically, and policy recommendations related to transition and upgrade of China’s regional economy will be reaised in correspondence.

## Prospect of Economic Growth in China from the 13th FYP Period to 2030

Topic: 811E  Special session: SIC-OECD-IDE/JETRO Joint special sessions on Development, Employment and Inequality (4)
Author: Shantong LI
Co-Authors: Jianwu HE

The year 2015 is the concluding year of implementation of “Twelfth Five Year” planning, it is also the year of preparation of “Thirteenth Five Year” planning. It has important meaning to analyze the future trend of growth of China’s economy at this crucial time, this will not only be favorable to understand better how Chinese economy will be changed currently or in coming future under “the new normal state”, but it will also provide useful references for the preparation of China’s “Thirteenth Five Year” planning, to create a better condition to achieve the successful transition of the Chinese economy. Therefore, this paper proceeds to clarify and analyze the undergoing changes of China’s economy currently in the first then three analytic scenarios are designed for

future growth trend of China on the previous basis, and the new version of DRCCGE model is applied to simulate the three scenarios, conclusions of study and policy recommendations are given in correspondence in the final part of this paper. The new version of DRCCGE model is based on 2010 SAM.

## Time Lag Model for Input-Output Multiplier

Topic: 716B  Methodological Aspects of IO Analysis (3)
Author: Xinru LI

Input- output technique has been widely used in many fields of national economy. At its core is the Leontief inverse matrix, namely input-output (I-O) multiplier. Most studies based on I-O multiplier neglect its time lag, leading to a misunderstanding that complete effect will be realized by one time immediately. The purpose of this paper is to build a time lag model for I-O multiplier. Time lag here comes from two sides: information transmission and production process. The former refers to time spent on microeconomic activities, such as finding source of goods and establishing orders. The latter is production time taken for the production of goods. In addition, we also take production lead-time into account. Using the power series expansion of Leontief inverse, it is well known that complete effect can be decomposed into direct effect and countless indirect effects. Under assumption of constant inventory, each effect corresponds to a time lag. We build a model to calculate average-weighted time lag of the complete effect. In empirical analysis, based on China's non-competitive I-O table that reflects processing trade in 2010, we calculate the average time lag of effect on domestic value added generated by each sector's export. The result shows that time lag of effect generated by processing export is shorter than that by non-processing export, which is meaningful for policy making.

## Chinese Environmentally Extended Input-Output (CEEIO) Database

Topic: 814E  Special session: Economic and Environmental Relationship in Asian-Pacific (2)
Author: Sai LIANG
Co-Authors: Xiaoping Jia, Shen Qu, Anthony shun Fung Chiu, Ming Xu

Addressing China's environmental issues requires the investigation of relationships between its economic activities and the biophysical environment. Environmentally extended input-output (EEIO) models can capture such relationships and uncover the structure of economies. EEIO models are hence increasingly used in studying environmental issues in China.
EEIO models are constructed based on EEIO databases. Existing EEIO databases for China are usually not publicly available, causing repeated efforts to construct EEIO databases for China. Data sources and estimation methods are also not always consistent with one another, making it hard to compare results of different EEIO models. Moreover, environmental accounts in existing EEIO databases are limited and not continuously updated.
We address these problems by building a consistent EEIO database for China covering a wide range of years, sector classifications, and environmental accounts. We make it publically available with open access for broad dissemination. The Chinese EEIO (CEEIO) database has the following advantages.
First, CEEIO covers multiple years (currently including 1992, 1997, 2002, and 2007) in which benchmark input-output (IO) tables are available in China. This database can also be updated to latest time points when related data are available.
Second, CEEIO is publicly available with open access (http://www.ceeio.com), which helps avoid

repeated efforts of database construction.
Third, CEEIO is constructed based on published data from China's statistics and widely used estimation methods from peer-reviewed articles, which makes the system boundary of this database consistent for multiple years and with previous studies.
Fourth, CEEIO has a wide range of environmental accounts, covering 243 types of resources and 30 types of pollutants. Environmental accounts of this database can be expanded when reliable data for emerging pollutants are available.
Fifth, CEEIO provides data in three categories of sector classifications: the original sector classifications in the government's benchmark input-output tables (i.e., 118 sectors in 1992, 124 sectors in 1997, 122 sectors in 2002, and 135 sectors in 2007), a 45-sector classification commonly used in China's environmental and energy statistics, and a 91-sector classification with temporal consistence and maximized sector resolution. Such sector classifications offer different options for users.
Lastly, environmental accounts of an economy comprise those for industries and those for households. Existing EEIO databases for China only cover environmental accounts for industries, ignoring those for households. CEEIO covers environmental accounts of households in addition to industries, allowing closed input-output modeling.
We demonstrate CEEIO database by evaluating environmental pressures of Chinese products in 2007. Comparisons of our database with previous studies validate its rationality and reliability.

## Impacts of Local Water Scarcity Risk on Global Trade Network

Topic: 811B  Disaster Analysis
Author: Sai LIANG
Co-Authors: Shen Qu, Zeqi Zhu, Ming Xu

Water scarcity is one of the most significant long-term risks worldwide. As economies become increasingly interconnected through international trade, local water scarcity risk in producing nations can potentially lead to cascading impacts to distant economies. Existing studies have revealed impacts of global production and consumption activities on local water use and scarcity; but the impacts of local water scarcity risk on the global trade network remain largely unknown. Analyzing the impacts of local water scarcity risk on the global trade network can reveal vulnerable nations and sectors, and hence support policy decisions on conserving water resources and strengthening the resilience of the world economy against water crises.
In this study we evaluate impacts of local water scarcity risk on the global trade network. Using data from the World Input-Output Database (WIOD) for 1995–2009, we first quantify local water scarcity risks for each sector in each nation based on water availability of the nation and water use and economic output of the sector. We then evaluate impacts of local water scarcity risks on the global trade network using the WIOD multi-regional input-output (MRIO) model. Based on the results, we identify nations and sectors that are vulnerable to distant water scarcity risks.
In 2009, approximately 9% of the global economic impacts due to water scarcity risk occur in foreign nations, a proportion that had been increasing steadily along with increasingly intensified international trade since 1995. For many nations, large portions of the economic impacts triggered by their local water scarcity risks happen abroad, such as Belgium (38%), Netherlands (38%), and Luxembourg (35%). At the same time, over half of economic impacts in some countries, such as Estonia (85%), Hungary (81%), Netherlands (78%), Lithuania (62%), Ireland (62%), Luxembourg (60%), and Belgium (52%), are due to foreign water scarcity risks.
The 'hotspots' identified in this study can be largely invisible to relevant parties, due to the growing complexity of the global trade network and the uneven distribution of water availability and water demand across the world. We anticipate our findings is able to help strengthen the

stability of the global trade network through guiding water-related investments of international institutions, foreign investments of firms, and the choices of upstream suppliers in critical sectors.

## A Quasi-Input-Output model to evaluate emission factors of purchased electricity from interconnected grids

Topic: 716Y  Energy IO Modelling (3)
Author: Sai LIANG
Co-Authors: Sai LIANG, Shen Qu, Hongxia Wang, Ming Xu

Electicity generation is a major source of atmospheric emissions (e.g., greenhouse gas, sulfur dioxide). With increasing electricity trade among power grids, accounting for emissions embodied in purchased electricity from interconnected grids is necessary for designing effective environmental policies. However, calculating emissions embodied in purchased electricity from interconnected grids is difficult, because it needs to trace the purchased electricity to the source of its generation through the complex grid network. To address this challenge, previous studies proposed approximate estimations using a variety of techniques such as iterative algorithms and adjusting direct electricity trades. Those methods are computationally demanding or simply cannot derive accurate solutions.

We solve this problem by realizing and exploiting the isomorphism between the intergrid electricity transmission network and the Input-Output (IO) model of an economy. Specifically, for a certain grid, electricity is generated (with the correponding enironmental impacts) and then mixed with the purchased incoming electricity from other grids, generating the toal electricity flux which in turn flows to consumers and other grids. Analogously, for a sector in the IO model, valued added is generated, and then combined with inputs purchased from other sectors, resulting in the total output which is in turn allocated to final consumption and other sectors.

Despite the correspondence between the structures of the two models, one cannot directly apply environmentally extended IO model to the electricity transmission network for emission accounting, since the activities generating environmental impacts are at different logical components (i.e., electricity generation for grid network vs. total ouptut for IO models). Therefore, we propose a Quasi-Input-Output (QIO) model, and derive two formulas for calculating emission factors of electricity consumption in an interconnected grid network, based on the quasi-Leontief inverse matrix and the quasi-Ghosh inverse matrix, respectively. We then show the equivalence between the two methods.

Empirically, we use two cases to compare our QIO model with other methods from previous studies. One is electricity trade between grids of 53 major countries/regions on the Eurasian Continent, and the other is the electricity trade between more than 100 interconnected Power Control Areas (PCAs) in North America. These two case studies show that our QIO model comes to approximately the same result as the iterative method. In addition, we also prove the equivalence between our QIO model and the iterative method (if infinitely executed). Moreover, our QIO model doesn’t need strong assumptions that other methods such as electricity trade adjustment rely on.

The QIO model we developed for the electricity transmission network represents a novel application of the IO theory. It can be readily applied to account for other evironmental impacts (e.g., water consumption) of purchased electricity in interconnected grids. We anticipate our model will be widely used in environmental policymaking with the rapid development of electricity trade markets. Furthermore, we also expect the theoritical framework of this approach can be applied to environmental accounting in other interconnected systems.

## Income distribution, technological progress, and structure change

Topic: 711E Special session: SIC-OECD-IDE/JETRO Joint special sessions on Development, Employment and Inequality (1)
Author: Chen LIN

Income distribution change and technological progress can cause the change of value added rate. The former depends on political relation and industrial policy, while the later shows the effect of technology. By using historical input-putput tables of China, this study decomposes these two factors for Chinese economy in the pre-reform era. Historical input-output tables of China are obtained from the project called China historical input-output tables (CHIOT), which estimates input-output tables (IOT) of China for every year from 1958 to 1973. Based on the availability of the statistic and firm-level data, the IO tables are set to be hybrid. In other words, the tables have both products in physical units and industries in monetary unit. The products in physical unit include 161 industrial products, covering almost all the major industrial product the pre-reform era. Meanwhile, In order to cover the sectors that cannot be rep- resented by the 161 industrial products, especially the agriculture and service sectors, 18 industries in monetary units are included to close the mode. Our analyze shows that the driving factor of the change of value added rate varies cross sectors.

## Growth and structural change of the Chinese economy prior to reform

Topic: 814X Structural Change and Dynamics
Author: Chen LIN

Using newly compiled Chinese historical input-output tables (CHIOTs), my paper reevaluates Chinese economic growth of the era prior to reform in a multi-sectoral framework. These hybrid tables are comprehensive covering 161 commodities in physical units, as well as 18 industries in monetary units. New results show that prior to the reform years, the Chinese economy achieved far from balanced growth. This motivates the multi-sectoral analysis, which reveals a growth strategy that favored industries with strong backward linkage. Thanks to the strong backward linkage, the newly built facilities of these industries raised the production efficiency of not only these industries also other downstream industries. This growth strategy fundamentally changed the economic structure and provided a foundation for the growth of the economic reform era. Meanwhile, the recession caused by the Cultural Revolution affected both the economic aggregate and structure. A simulation analysis shows that compared with those of the reality, GNP of 1973 in the no-recession-scenario doubled and its percentage of light industries nearly tripled, to 22.14%.

## Value Added Trade and Wage Stagnation in Taiwan

Topic: 516D Trade in Value-added
Author: Shih-mo LIN
Co-Authors: Jin-Xu Lin, Kuei-Feng Chang

Taiwan has witnessed wage stagnation for almost two decades. The reasons contributing to this stagnation are many. Among them, globalization, production outsourcing, the shift of factories to neighboring countries, and decreasing labor share of national income are frequently mentioned

ones that deserve further investigation. This paper contributes to this area of research by trying to incorporate the concepts of value added trade into the analysis of identifying the most important factors that caused wage stagnation in Taiwan. Our analysis will be divided into two parts. First, we make use of the world Input-Output Database compiled and maintained by the European Union and the decomposition approach developed by Koopman et al. (2014) to decompose the sectoral gross trade data and gain the value added that are attributable to domestic factors by sectors, and across periods. Second, we set up an empirical estimation equation based on an index decomposition procedure for the share of labor income in GDP by sectors, and then estimate the equation econometrically as a panel data model. Our analysis results for Taiwan will be compared to that of Japan to figure out the similarities and differences between the two countries.

## Temporal and spatial distribution of global mitigation costs: INDC role and generation equity

Topic: 514C  CGE/econometric IO Modelling (1)
Author: Jingyu LIU
Co-Authors: Shinichiro FUJIMORI

In the working group three of the fifth IPCC assessment report, there are numbers of scenarios corresponding to 450ppm CO2 equivalent concentration stabilization, which is generally known as what we call 2 degree target. RCP (Representative Concentration Pathways) 2.6 is one of them and the summation of all countries' emissions submitted as INDC (Intended Nationally Determined Contributions) is expected to be larger than RCP2.6 in 2030. To achieve the 2 degree target, additional emission reduction is needed to fill the gap between them after 2030. Such mitigation scenario consistent with INDC and achieving the 2 degree target would have different mitigation costs spatially and temporally, and influence on the generation equity both in intra- and inter- generations. Here, we have the three research questions, namely 1) for inter-generation equity, does INDC cause more harm to the future generation comparing with RCP2.6? 2) For intra-generation equity, if we follow INDC pledges, would we gain more intra-generation equity? 3) Would it help to improve generation equity regarding mitigation costs if we could have more stringent reduction target than INDC?
This study answers these questions using the AIM/CGE (Asia-Pacific Integrated Model/ Computable General Equilibrium) model, which is a recursive dynamic general equilibrium model that covers all regions of the world. GTAP and energy balance table are used as a basis of the SAM and energy balance table and reconciled them with other international statistics such as national accounts. The data in the year 2005 is used as the base year calibration data. GHG emissions are calibrated to EDGAR4.2.
The following four scenarios were analyzed: BAU, 26W, 26W_INDC and 26W_S_INDC. The BAU entails no emissions constraints and follows current trends in energy technologies. The 26W scenario has emissions constraints that approximately meet the emission target in RCP 2.6. It uses a uniform global carbon price to achieve the emission target. 26W_INDC scenario also meets the radiative forcing target approximately achieves 2.8 W/m2 in 2100 (not 2.6 but it is close enough considering temperature changes) and INDC pledges are satisfied before 2030 and a uniform global carbon price is assumed thereafter. 26W_S_INDC scenario is similar to 26W_INDC scenario except that each country's INDC emission target increases by 10 percent compared to 26W_INDC. The socioeconomic assumptions behind of all three scenarios follow SSP2 socioeconomic assumptions. The target period of assessment is 2020 to 2100.
To make current and future mitigation costs comparable, we introduce discount rate. The discount rates are decided using the following function (a). δ is the pure rate of time preference

for the present. g(t,r) is the GDP growth rate in region r and time t. η(r) represents inequality aversion in region r. Previous studies often assign a value ranging from 1 to 2 for inequality aversion. ρ(t,r) is the discount rate in time t for region r.

$$\rho(t,r)=\delta+\eta(r) * g(t,r) \quad \text{(a)}$$

We get GDP loss results as mitigation costs in the above scenarios from AIM/CGE model. To analyze inter-generation equity, we divide the year 2020 to 2100 into two generations. Current generation is 2020 to 2060. Future generation is 2060 to 2100. Then, we compared NPV (Net Present Value) of GDP losses in the scenarios. For intra-generation equity analysis, we focused on the relationship between the GDP loss rate and GDP per capita across regions in different years as well as using NPV of GDP loss rate as average values.

The results show that 26W_INDC has low mitigation cost in the former period, but high in the latter period comparing with 26W. Therefore, if we use ordinal number 2.0 as the inequality aversion parameter, 26W shows better inter-generation than 26W_INDC. More than 2.66 in the inequality aversion parameter makes 26W_INDC a better one. More stringent emissions reduction than INDC in 26W_S_INDC scenario could give us better inter-generation equity. Regarding intra-generation equity, 26W_INDC is better than 26W in average. It is because INDCs tend to have stronger reduction targets in high income countries which would have higher mitigation costs than low income countries. The different years' results for intra-generation equity show that INDC improves intra-generation equity before 2055. But after 2055, INDC has slightly negative impacts on intra-generation equity.

From the results of this study, we suggest that to improve inter-generation equity, each country should commit more emission reduction target before 2030. Furthermore, to improve intra-generation equity, we should have continuous consideration for low-income countries in global climate change cooperation after INDC.

## Carbon Tax Policy under Renminbi Appreciation: a Financial CGE Model Analysis

Topic: 516A  Financial Analysis
Author: Jingyu LIU

In the 20th century, Chinese economy faced problems coming along with double favorable balance. Cases of trade frictions are growing. So does the international pressure on Chinese government to allow RMB appreciation. On the other hand, the monetary authority had to give up part of the independence and flexibility of monetary policies, limited to the dollar peg, to respond to the rapid increasing of exchange reserves. There had been growing pressure on exchange rate policy reform and RMB appreciation. Chinese government has promoted RMB exchange rate reform since 2005. RMB has appreciated over 30% since then. The appreciation of RMB increases the prices of exports and decreases the prices of imports. Since energy intensive exports accounts for a large proportion of the total exports, Trade structure is changing too. RMB appreciation might have positive effects on carbon emission reduction. Meanwhile, a carbon tax policy is under consideration to achieve environmental targets in China. Carbon tax charged in tradable goods industries would have impacts on trade surplus. Thus, carbon tax policy might help to reduce the pressure of RMB appreciation. In the existing literature, there have been studies on carbon tax policy. But few of them are discussing carbon tax policy under exchange rate fluctuation. This paper tries to fill this gap and to study the difference of carbon tax policy when exchange rate is stable or appreciating using a financial CGE model.

This is a static single-country CGE model with a financial sector. This model traces the interaction between various financial markets and real markets. The model should be able to simulate effects of changes in the interest rates, credits, and other financial variables on the real

economy, as well as effects of investment decisions, product pricings, and other real economic behaviours on the financial markets. The database of the financial CGE model is the Financial Social Accounting Matrix (FSAM) with extended financial sectors. Accounts in our FSAM are: 42 production sectors , current accounts of institutions (household, energy enterprise, energy-intensive enterprise, other enterprise, government, rest of world), financial accounts of the same institutions, bank systems (commercial bank and central bank), and financial asset accounts (deposit, loan, enterprise bond, government bond, foreign asset, FDI, foreign lending and so on). The benchmark data of the financial CGE model are obtained from a Chinese social accounting matrix of 2007 for the real side, and the flow of fund tables, balance sheets, and balance of payment tables of 2006 and 2007 for the financial side. The data of the enterprises are calculated from the annual reports of the listed companies. For more detailed model description, please refer to Liu et al.(2015).
From the results, we find that RMB appreciation helps to reduce CO2 emission. And carbon tax policy would help to reduce trade surplus of China as well. When we are calculating the optimal carbon tax rate, we should not ignore the exchange rate fluctuation and its impact on the trade structure, industrial structure and the emission reduction amount. If we consider RMB appreciation, the optimal carbon tax rate should be lower than that when RMB exchange rate is stable.  If RMB exchange rate keeps rising in the future, the carbon tax rate should be adjusted gradually as well.

## China’s virtual SO2 emission transfer embodied in interprovincial trade: a multiregional input-output analysis

Topic: 514E  Enviromental Analysis for Development (1)
Author: Qiaoling LIU

Currently, China is deeply troubled by its severe domestic regional air pollution. The natural spread of atmospheric pollutants across administrative boundaries has received wide attention. However, attention should also be paid to the flows of pollutant emissions embodied in intereregional trade given the closer interregional economic connections. Different from existing researches which based on the model of bilateral embodied emission in trade, this study analyzes the emissions embodied in interprovincial trade based on multiregional input-output model of 30 provinces in China to capture the complicated production linkages among provinces and track the direct and indirect embodied emissions in the entire production process of the final products. Empirical study is carried out on embodied SO2 emissions in 2002 and 2007 in China. The preliminary results show that the embodied SO2 emissions in interprovincial trade accounted for 27.58% of the total SO2 emissions in China in 2002 and 35.25% in 2007, exhibiting an increasing trend over time. Inner Mongolia, Shanxi and Guizhou were the major embodied emission-exporting regions, and were mainly from the power, nonmetal mineral production, chemical and metal smelting sectors; and the emissions exported mainly ended up in rich regions including the Yangtze River Delta region, Beijing, Tianjin and Guangdong due to their consumptions in the sector of construction, food products and transport equipment. Furthermore, rich provinces had a pollution terms of trade less than one. Given that they were net importers in interprovincial trade, this trade pattern may result in pollution leakage which is unfavorable for the reduction of pollution emissions.

## The Bias in measuring the industrial linkage between China and the rest of World

Topic: 809Z  International Trade (1)
Author: Ruixiang LIU

It is well known that China’s export depended on the import intermediated input by processing trade. So the traditional measurement of industrial linkage will overestimate the role and influence of China in the world’s production network. This paper aims to investigate the industrial linkage between China and the rest of world by using input-output analysis. Data of WIOT from the period 2001-2011 is used to analyze the change of international industrial linkage. Two different results of measurement are compared which shows that both the backward linkage and forward linkage between China and the rest of world are overestimated. Taking China as exogenous, this study further explores its economic effects on other countries, including production-inducing, supply-shortage, and price effects.

## Input-Occupancy-Output Economics

Topic: 714Z  IO Accounts and Statistics (2)
Author: Xinjian LIU

There are some drawbacks in traditional mainstream economics, especially, it makes heavy theoretical problems because of lacking the consideration of intermediate products, such that the stagflation caused by oil crisis cannot be explained reasonably. Input-occupancy-output (IOO) techniques can be a strong tool to reform traditional economics. The accurate economic meanings of gross domestic product (GDP) can be revealed through the analysis of an input-output table, which could discover the theoretic foundation of the reform to account R & D inputs into GDP. An AS-AD model which is created by including intermediate flow quantity can interpret the stagflation issue more efficiently than the traditional theory. An dynamic equilibrium model based on the price model and basic dynamic model of IOO can reveal the phenomenons of inflation and income difference expansion following economic growth. It could be believed that the In-depth development of input-occupancy-output economics promote the formation of new modern economics paradigm.

Key words: input-output economics; input-occupancy-output; GDP, AS-AD analysis; economic growth and inflation

## Industrial Structural Changes of Beijing Economy：A Field of Influence Approach

Topic: 814D  Region/country-specific Analysis
Author: Xinjian LIU

As China’s capital, Beijing’s economic structure has experienced great changes in recent 20 years. Many heavy industrial factories have been move out the city. This paper uses the concept of the field of influence and the method of multifactor and multi-order impact analysis (MMIA) to make a quantitative analyzation to the structural changes. MMIA is applied here as a substitution of SDA. The analysis was based on 10 IO tables from 1987 to 2010 with 29 sectors. The results show that final demands played main role to the share changes for more than two third sectors in

Beijing Economy. The changes of intermediate input coefficients made dominant contributions for four sectors which are the sectors of Mining of Metal Ores, Mining of Nonmetal Ores, Power and Water, Commercial Business. The paper also made a taxonomy to the 29 sectors according to the main field of influence and sign combinations of influential components.

KEYWORDS: Industrial structural change, field of influence, MMIA, Beijing's economy

## A method to identify key sectors and their feedback loops for a certain industry in one economy and its application in the evaluation of the role of real estate industry in Chicago

Topic: 814D Region/country-specific Analysis
Author: Xiuli LIU
Co-Authors: Geoffrey J.D. HEWINGS

This paper explores the possibility of merging into a 'combined' proposal three standard I-O methods identifying key sectors and their feedback loops, namely Hypothetical Extraction, Field of Influence and the Hieratical Feedback Loop Method. The novelty of the combined formulation allows us to disaggregate the backward stimuli of one certain sector into total, internal, external backward indicators and the corresponding feedback loops. With Chicago input-output tables, we applied this method to single out key sectors that connected with real estate industry in Chicago economic system-specifically. In addition, the approach provides insights into the feedback loops of the industrial linkages that are associated with the production and distribution of real estate industry. From this analysis, the sectors that impact the intensity of the backward effects of the real estate industry and their feedback loops can be identified, thereby providing a more comprehensive set of perspectives for the evaluation of the role of real estate industry in the economy.

## Identification of key sectors in a General Equilibrium Model: A comparative empirical analysis for Andalusian economy

Topic: 811C CGE/econometric IO Modelling (2)
Author: Jorge M. LÓPEZ ÁLVAREZ
Co-Authors: Manuel A. CARDENETE

The ability to represent and describe the interactions and flows in an economy and the possibilities of capture the multiple simultaneous relationships among economic agents, make the Computable General Equilibrium (CGE) models in very useful tools for economic purposes, allowing a counterfactual framework for ex ante analysis in the economic system.

In that sense it is possible to study the impact of exogenous shocks in the economy under this approach having like one of its main features the provision of a view of the redistribution of such impacts over all the economic activities with a high level of explanation based on assumptions of economic theory.

Using Social Accounting Matrices as databases it is possible to determine those economic sectors more relevant for the economic structure in quantitative terms, for the influence of one activity in each other sector and overall the economy. Originally, this has been a field studied in the interindustrial analysis and its techniques.

So, the purpose  is to apply a traditional methodology (Hypothetical Extraction Method) for detection of key sectors inside a CGE model, comparing its results in both cases and capturing the missed interactions that traditional methodology neglects. Offering results that respect all the behavioral simultaneous equations that represent the functioning of an economic system.

This is an empirical work that analyzes the regional Andalusian economic during the period between 1990 and 2005 using regional Social Accounting Matrices for every five years. The results will allow us to observe the differences in both types of techniques in quantitative and qualitative terms and the reason of the differences in the determination of key sectors in an economy. Providing, in this sense, a new basis for useful analysis for economic policy decisions.

## Peak Trade? An Anatomy of the Recent Global Trade Slowdown

Topic: 814Z  International Trade (3)
Author: Bart LOS
Co-Authors: Robert STEHRER, Gaaitzen DE VRIES, Marcel Timmer

Global trade growth has recently been sluggish, after decades of rapid expansion. Since 2011, growth in exports of merchandise has not been faster than growth in global GDP, suggesting that globalisation has reached a ‘peak’. Indeed, the 1990s and 2000s might have been exceptional periods in world history with rapid evolution of international supply chains. As the elasticity of trade to global GDP reverts back from its peak value we might be seeing the end of hyper-globalisation. Has globalisation really reached its peak, or is sluggish trade growth merely reflecting weak demand in the aftermath of the 2008 financial crisis? To date current research does not provide a consensus, as shown by various contributions to a recent book on this topic edited by Bernard Hoekman. Various explanations have been offered which can be grouped into two major classes: cyclical factors, related to the structure of global demand and structural factors, mainly related to changes in international production structures.
Existing research relies heavily on econometric estimation of long- and short-run trade-elasticities of GDP, basically relating imports to GDP at the country level. This approach is based on a model of the world with trade in final goods only. At the same time, the studies try to determine changes in international production structures through a variety of ad-hoc methods and pieces of evidence. Importantly, the analyses of the effects of demand and production changes are separately carried out. In contrast, in this paper we provide an ex-post accounting of the effects of changes in both demand and in international production systems in one coherent modelling framework. The key to derive these import elasticities is through tracing all stages of production in an exogenous demand driven model in the Leontief tradition, which has by now become an established methodology in measuring value added in trade. We trace all imports in all stages of production needed for a particular product. In contrast to previous work these include not only imports by the country itself to satisfy domestic demand, but also imports that were needed to make by other countries in earlier stages of production. It is the change in these total import elasticities that provides novel information on changes in GVC trade.
Having derived the elasticities, we will employ a novel structural decomposition analysis of the annual change in global imports. By keeping the structure of global demand fixed, we find the contribution of changes in import elasticities of production. Conversely by keeping elasticities constant we derive the contribution of changes in structure of global demand. By grouping products and countries we can test the various alternative explanations for the global trade slow down since 2000. Using an update of the World Input-Output Database (WIOD) through 2014 we will for the first time be able to make an anatomy of post-crisis world trade. It decomposes

changes in global imports into changes in the structure of world GDP and changes in the import elasticity of production. This will for the first time offer insight into the relative magnitudes of the various cyclical and structural determinants of the recent global trade slowdown, derived in one coherent framework.

## Probabilistic, Bayesian updating of IOTs: application to WIOD

Topic: 714B Methodological Aspects of IO Analysis (2)
Author: Oleg LUGOVOY
Co-Authors: Andrey POLBIN, Vladimir POTASHNIKOV

The paper summarizes the authors' efforts on developing and application probabilistic method(s) for updating IO tables, preliminary presented and discussed on previous IIOA conferences. The core of the methodology is Bayesian framework which combines an information from observed data, additional believes (priors), and related uncertainties into posterior joint distribution of input-output table (IOT) coefficients. As we show in the paper, the framework can be applied to various IOT problems, including updating, disaggregation, evaluation of uncertainties in the data, and addressing incomplete/missing observations. The flexibility of the methodology is partially based on sampling techniques. We apply modern Monte Carlo Markov Chains (MCMC) methods to explore posterior distribution of the IOT coefficients.
The paper includes three parts. In the first part we discuss the conceptual framework of application of Bayesian techniques to probabilistic updating of IOTs, disaggregation, addressing measurement errors in data, missing observations, various specifications of priors, and computer implementation. In the second part we test the methodology on actual data, World Input Output Database (WIOD), and compare its performance with other mainstream techniques of IOT updating. In the third part we apply the methodology to build probabilistic IOTs for Russia. Based on information from national accounts for 70+ industries, and preliminary official IOT estimates for 15 main sectors, published by Rosstat for 2006, we are trying to reconstruct probabilistic IOTs for 77 sectors, using the Bayesian techniques for disaggregation and updating IOTs up to 2014.
In addition to another IOT updating technique, the main contribution and advantage of proposed methodology is a straightforward and practically achievable quantification of uncertainties in input-output tables, consistent with directly and indirectly linked with IOTs observed data, and any amount of additional information, which can be expressed by inequality constraints for IO coefficients and their linear combinations.

## Compilation of SUTs as an integral part of the National Accounts in the United Nations Handbook

Topic: 711Z Special session: Compilation Issues of Supply, Use and Input-Output Tables
Author: Sanjiv MAHAJAN

The UN Handbook on Supply, Use and Input-Output Tables with Extensions and Applications consistent with the SNA 2008 and BPM 6 will be published in 2016. This Handbook is a completely new version and covers the use of the I-O framework and extends the scope of previous efforts, again with a focus on compilation and analysis as well as providing recommending guidelines for future best practice.

The Input-Output framework consists of Supply Tables, Use Tables, Input-Output Tables as well as extensions and analyses. Recognising the importance of these products, the UN has issued

handbooks from time to time providing compilation guidance to help countries compile these tables, the last being in 1999. Revision of the international standards for macro-economic accounting and classifications like the SNA 2008, BPM 6 and ISIC Revision 4, required that the UN Handbook of Input Output Table Compilation and Analysis was revised. In addition, the Integrated Economic Statistics Guidelines have identified the need to update the Handbook as part of main building blocks of the statistical production process as statistical tool for reconciliation and use as organisational tool of statistical production process. The underlying concepts and principles of the Generic Statistical Business Process Model (GSBPM) have been used as an input in this Handbook covering the business process and stage of production processes underpinning the monetary and physical SUTs and IOTs.

The underlying aims and principles forming the drivers and content of this Handbook cover:

• Consistency with international standards like SNA 2008, BPM 6 and ISIC Revision 4.
• The rapid evolution and use of Supply and Use Tables to reconcile the components underpinning GDP within National Accounts in National Statistical Offices (NSOs).
• Provide recommendations/steer on best practice, and where appropriate, recognise acceptable alternatives, and facilitate practical guidance for countries with less developed statistical systems or very limited resources, etc.
• Provide greater links and integration of the I-O family of products including the links to the sustainability agenda covering the environmental dimension and System of Environmental-Economic Accounting (SEEA).
• A strong integration theme driving forward improved quality, coherence and consistency through close and inter-related production processes:
• Supply and Use Tables and Input-Output Tables should be produced together at the heart of the National Accounts within the NSOs. This may challenge the compilation of these tables, in various countries where they may be compiled in National Central Banks.
• Environmental Accounts and Regional Accounts are closely linked to the I-O products and should also be produced within the core National Accounts within the NSOs.

The paper will focus on compilation issues of the Supply and Use Tables at current prices and in volume terms.

## A Social Accounting Matrix model approach to appraise sectors with a zero deficit public budget

Topic:
Author: Alfredo J. MAINAR CAUSAPÉ
Co-Authors: Patricia D. FUENTES SAGUAR

The aim of this paper is to develop a mixed empirical methodology to identify sectors with capability of growth of output and employment, in a zero public deficit framework, considering also the environmental implications of each sectors production. The economic activities are ranked and selected following their output, employment and emissions multipliers. For empirical analysis, it is used a Social Accounting Matrix of the Spanish economy for 2008.
In the current context of economic crisis (although it is beginning to overcome), it is particularly necessary to determine which economic sectors have a special capability to develop the growth of output and employment, without forgetting the mandatory environmental commitment, in order to prioritize the destination of public spending. Thus, this paper proposes, as its principal novelty, an empirical way of determining sectors with greater potential of the economy in a zero

deficit context, using different approaches that complement each other, with the idea of identifying those areas where a higher rate of return exist as well as those where reductions can have less impact.
The first of these approaches is a description of the economic structure of the country through classic output multipliers, to describe the general behaviour of the Spanish economy activities. The second one classifies industries according to their capacity to generate employment. This analysis is completed by evaluating for each branch of the economy their impact on environment, using as proxy their Greenhouse Gases (GHG) emissions.
For empirical analysis, we use a Social Accounting Matrix of the Spanish economy for 2008 (SAMESP2008) estimated by the authors. Since the last "official" Spanish symmetric table economy refers to 2005, this paper uses a symmetric matrix obtained from the latest published tables (at the time of its completion ) of Supply and Use of the Spanish economy , referring to the year 2008. The symmetric table is obtained "industry by industry" and following the fixed product sales structure assumption), taking into account that detailed micro SAM contains 84 accounts: 73 productive sectors, 2 production factors (Capital and Labour), 3 institutional sectors (Households, Enterprises and Government), 3 accounts for taxes and subsidies, a Saving-Investment account and 2 accounts for the Rest of the World (European Union and Rest of the world).
In order to analyse the context of zero deficit rule, it is considered in this paper that Public Sector (Government account) is the only exogenous variable, assuming that all other industries and institutional sectors are working to meet their needs. This can imply a bias, especially because of the endogeneization of foreign sector, generating an overestimation of the multiplier effect and contravening the hypothesis of "small country". To solve this problem, it's proposed to use a special version of well-known linear SAM model, with a slight modification to maintain imports as exogenous, working with an extension of domestic technical coefficients matrix.
To evaluate the efficiency of public spending and identify areas that should be applied for attaining higher economic growth and employment, the previous calculations were performed, taken as exogenous variable the government account. This simple initial exercise should be taken as a mere qualitative and incipient indicator of this efficiency measure, without following quantitative values. There is a strong restriction for this: it should be borne in mind that an investment in any sector by the Government means, in times of austerity and deficit zero, a withdrawal of resources from other sectors, with the consequent negative impact on growth and employment. So, it is considered that maintaining a zero deficit as the public sector spends a monetary unit in a sector; public expenditure in other sectors is reduced, following four alternative criteria for select the sector of reduction.

## Analysis of a developing economy using linear multi-sectorial models based on a home production for home consumption Social Accounting Matrix: the Kenya case

Topic: 711C  Social Accounting Matrix
Author: Alfredo J. MAINAR CAUSAPÉ
Co-Authors: Pierre BOULANGER, Hasan DUDU, Emanuele FERRARI

The purpose of this communication is twofold: firstly, to present and describe the process of estimating a Social Accounting Matrix (SAM) structured especially for developing countries, incorporating the economic fact of home production for home consumption (HPHC) together with a detailed breakdown of the agricultural sector and also considering different regions and agro-economic zones. Furthermore, using this matrix in applying a customized version of the model of mixed-multipliers, extending it to supply models that allow for better analysis of facts

such as increased water availability or improved land factor productivity. Specifically, it has been estimated a SAM Kenya by 2014, applying these techniques to analyse the impact of the discovery of new sources of vital natural resources (as huge aquifers) and potential improvements in land productivity.

In developing countries the fact that many households combine a dual and non-separable role as consumers and producers is particularly important, since the activities carried out in this way have important weight in the national economy, especially in the agricultural activities. In this sense, it may be useful to incorporate into SAMs the home production for home consumption (HPHC). HPHC represents a major component of both household incomes and expenditures; this is especially so for the very poorest who overwhelmingly live and work in rural communities. Typically peasants farmers in developing countries retain at least part of their production for home consumption, which means the mechanisms that determine the value of commodities they home consume are different to the notionally same commodities they might buy on the market. Despite these important issues the distinction between market and HPHC commodities is typically unreported and merged into the commodity accounts of SAMs, compromising its ability to provide information about the behaviour and well-being of the poorest (rural) households.

Therefore the analysis proposed in this paper will be based on a new Social Accounting Matrix (SAM) for Kenya, the 2014 Kenya SAM, incorporating the HPHC issue. This SAM, estimated by the authors, will contain a proper disaggregation of activities (with focus on regional agriculture), commodities and households based on the economic characterization of the different regions comprising the country. 2014 Kenya SAM is a novel contribution as it is estimated from the new rebased National Accounts (including a short version of Supply and Use Tables) for Kenya and the micro-data from Kenya Integrated Household Budget Survey 2005/06 (KIHBS 05/06). They have been also used other relevant databases related with agriculture and labour market, and has been updated too and used auxiliary the production structure of a previous 2007 SAM elaborated by IFPRI.

The 2014 Kenya SAM consists of 54 activities producing 70 commodities using 3 types of labour (skilled, unskilled and semi-skilled) in 10 regions (30 labour accounts in total), 3 types of capital (agricultural, non-agricultural and livestock) and land. An enterprise account and 24 household accounts (rural and urban households in 7 regions and 10 urban households in 2 metropolitan areas which are disaggregated according to expenditure quintiles). The regional disaggregation follows Agro-Ecological Zones (AEZ) classification and main metropolis, allowing the study of specific problems related to certain regions.

The methodology framework will be the linear multipliers analysis, combining the classic techniques of accounting multipliers (decomposition of effects, detection of key sectors, etc.), with a customization of the well-known model of mixed multipliers. Mixed-multipliers part of the consideration, within the endogenous variables, of a set of variables whose output are fixed and can’t freely respond to increases in final demand (e.g., activities / commodities / factors whose elasticity cannot be considered infinite, but almost null). But mixed multipliers obtained, although allow estimating more realistically the effects of exogenous shocks on the endogenous accounts model, they are not the most appropriate to estimate the impact of, for example, an increase in the availability of water or an increase in land productivity, because they are based on Leontief multipliers, a demand-driven model. So a customized supply-driven model will be used (as a novelty), namely a version of mixed multipliers in the Ghosh model, using the allocation matrix instead of the technical coefficient matrix, obtaining supply-driven mixed multipliers.

## Biofuel Assessments in the Australian IELab

Topic: 814W  Special session: Input-Output Virtual Laboratories (2)
Author: Arunima MALIK
Co-Authors: Arne GESCHKE, Manfred LENZEN

Growing concerns about energy security and climate change have prompted interest in Australia and worldwide to look for alternatives of fossil fuels. Among the renewable fuel sources, biofuels are one such alternative that have received unprecedented attention in the past decade. Cellulosic biofuels, derived from agricultural and wood biomass, could potentially increase Australia's oil self-sufficiency. In this study, we carry out a hybrid life-cycle assessment (LCA) of a future cellulose-refining industry located in the Green Triangle region of South Australia. We assess both the upstream and downstream refining stages, and consider as well the life-cycle effects occurring in conventional industries displaced by the proposed biofuel supply chains. We improve on conventional LCA method by utilising multi-region input–output (MRIO) analysis that allows a comprehensive appraisal of the industry's supply chains. In particular, we construct a MRIO table on the Australian Industrial Ecology Virtual Laboratory, and hybridise that with detailed engineering process data on cellulose refining. Using MRIO-based hybrid LCA, we evaluate the social, economic and environmental impacts of lignocellulosic biofuel production. Our results reveal that a lignocellulosic biofuel industry will create significant new jobs and enhance productivity and economic growth by initiating the growth of new industries in the economy.

## Trade flows estimation within inter-country input-output compilation

Topic: 716Z  Special session: International Trade Data Analysis in the Framework of Supply, Use and Input-Output Tables
Author: Pedro MARTINS FERREIRA

The corner stone for building an inter-country input-output (ICIO) table is to estimate trade flows that are consistent among country's IOT. There are many factors that contribute for making the estimation of trade flows a challenging and demanding task: primary data sources asymmetries, different flows valuation, re-exports, merchanting and goods sent abroad for processing are examples of these challenges. In this paper, some of these issues will be addressed so the paper pretends to be a contribution for estimating trade flows needed for the compilation of an ICIO. A methodology to correct trade asymmetries while being consistent with imports and exports reported in country's IOT based on non-linear optimization with constraints is proposed. In addition, a method to discount the effect of re-exports, i.e. country B imports from country A and exports to country C, on the geographical distribution of trade is proposed as well. This methodology is applied to 2010 and 2011 supply and use tables for each EU country. The novelty of the new approach is to provide a complete set of estimates of trade flows, consistent with EU countries' supply tables at basic and purchaser's prices and respective valuation matrices. All this information pretend to be a useful starting point for building an ICIO for EU fully compliant with national IOT.

## Resource Logistics as a Support Tool of Science, Technology and Innovation Policy Decision

Topic: 514A  Special session: Science for Re-designing Science, Technology and Innovation (SciREX) Policy
Author: Kazuyo MATSUBAE
Co-Authors: Tetsuya Nagasaka, Kenichi NAKAJIMA, Keisuke NANSAI

Scientific technologies are researched, developed, and then disseminated to the wider society under resource and environmental constraints. Resource limitations lead to the creation of new green innovative technologies, which in turn generate additional resource demands. In fact, innovations in science and technology (S&T) are important drivers of economic performance. However, we have inadequate knowledge to develop scientific and technological innovations to solve problems and to implement new social value in society. In order to facilitate innovation, it is necessary to understand the flow of resources in the supply chain and its life cycle impacts - so called “resource logistics”. With the increased global concerns of resource and environmental constraints of recent years, the responsibility in mining, as a constituent of social responsibility associated with resource extraction and usage, is becoming increasingly important.
In this study, we evaluated the supply chain risks behind direct and indirect resource use for Japanese economy with focusing phosphorus. This case study revealed a complex set of patterns, with some countries relying heavily on just one or two countries to meet their commodity needs, and others drawing from a wide range of sources. In many cases, a strong dependency was noted on a country which itself was heavily dependent on another source for its commodity needs directly and indirectly. Considering the economic structure and geopolitical problems, it was found that special attention should be paid to maintaining a stable supply of agricultural nutrients resources to ensure stability in agricultural production as well as in the many industries which use phosphoric acid(P) as an essential chemical materials.

## Spatial Analysis Of Regional Input Output Of The Automotive Supply Chain And Its Impact On Economic Development In The Economic Functional Region Northeast Mexico.

Topic: 814A  Regional IO Modelling (3)
Author: Marcos N. MAYA
Co-Authors: José M. SANCHEZ, Normand Asuad Sanen

The automotive industry is of great economic importance for the creation of value added and employment, so it is considered by the national industrial policy as a key factor for development. Even state governments in Mexico promote its establishment in their territories as it is a factor of regional growth and also to take advantage of the export market that the economic openness has given for three decades. However, the production chain of local firms with the transnational companies that lead the automotive industry represent an unfulfilled goal and this becomes evident by the strong dependence on imports from the point in the production chain. This separation does not allow the benefits of the economic liberalization model to achieve regional development.

This paper analyzes the functional economic region of Northeast Mexico, which contains one of the most important automotive clusters in Mexico which is spatially structured in a metropolitan corridor that runs from Saltillo to Monterrey. However, it articulates other cities that specialize in branches that supply inputs located in various internal sub-regions, including the border,

generating not only intra subregional interaction but also interaction with other national regions, and of course with the rest of the world where many inputs are imported from. Therefore, the aim of this article is to answer the question: What is the impact of the automotive industry in regional development through the analysis of its production chain in Functional Economic Region in the Northeast? For this purpose, the regional input-output matrix (MIPR) is constructed through the bottom-up methodology, using the main regional economic accounts and analyzing the economic interactions. So, the main economic subregions are identified validating their economic interaction with spatial dependence as measured by Moran and Lisa indices; subsequently, the main economic accounts of every subregion are identified and developed, focusing on key dominant sectors and those that correspond to the automotive industry. Finally, there is an analysis of economic interactions and the construction of matrices of uses and origin of resources taking national tables as reference.

In the light of these results, the regional Input-Output matrix is constructed through economic transactions technical and total coefficients, which is complemented by the identification of key chains, drag chains, base chains and independent chains in the region and its subregions by the Rasmussen methodology, focusing on the chains associated with the automotive industry. Subsequently, by analyzing vertical specialization, the proportion of external and regional added value is estimated, incorporating automotive exports. Additionally, the connectivity of the northeastern region with and without imports is calculated by the analysis of the determinants of the matrices of total regional intermediate consumption and without imports.

To analyze the contribution to regional development, multipliers of the subregional matrices are analyzed and the impact of the growth of value added in the automotive industry on local employment is witnessed. To complement this there is a statistical evaluation of the impact on the main variables of economic and social development of the region.
Statistical information comes from the 2014 and earlier economic censuses, GDP and National Accounts report from the National Institute of Statistics and Geography (INEGI) of Mexico, which provides data by industry and by municipality; as well as officials and business surveys available at the state level.

The contribution of the above methodology is based on an effort to collect and estimate data through the approach "bottom up" and through regional accounts, which has not been done in Mexico before. This allows us to know more precisely the heterogeneity and the impact of the local functional economic structure. Also, the contribution to regional development obtained through the local industrial policy that attracts foreign direct investment is inferred.

Keywords: Automotive industry, regional matrices, chains, enclave, vertical specialization, regional development.

## Measuring Smile Curves in Global Value Chains

Topic: 809E Special session: SIC-OECD-IDE/JETRO Joint special sessions on Development, Employment and Inequality (3)
Author: Bo MENG
Co-Authors: Ming Ye

The concept and logic of the “smile curve” in the context of global value chains has been widely used and discussed at the individual firm level, but rarely identified and investigated at the country and industry levels by using real data. This paper proposes an idea, based on an

inter-country input-output model, to consistently measure both the strength and length of linkages between producers and consumers along global value chains. This idea allows for better mapping of smile curves for countries and industries according to their positions and degrees of participation in a given conceptual value chain. Using the 1995-2011 World Input-Output Tables, several conceptual value chains are investigated, including exports of electrical products from China and Mexico and exports of automobiles from Japan and Germany. The identified smile curves provide a very intuitive and visual image, which can significantly improve our understanding of the roles played by different countries and industries in global value chains. Further, the smile curves help identify the benefits gained by these countries and industries through their participation in global trade.

## Revisiting the Long-range Transboundary Black Carbon: The Role of International Trade and Atmospheric Transport

Topic: 814F Trade and Environment
Author: Jing MENG

Black carbon (BC), emitted mainly from combustion processes, both owns a large warming potential to global climate and poses a great threat on human health. Though long-range atmospheric transport of BC has been extensively studies, little is known about BC redistribution via international trade. Here, for the first time, we evaluated the virtual BC transport based on a multi-region input-output (MRIO) analysis, and compared which to long-range atmospheric transport of BC using the Model for Ozone and Related Chemical Tracers (MOZART-4). We build the global BC emission inventory with high sectoral resolution, and use the MRIO table derived from the Version 9 of GTAP database to quantify the virtual transport of BC. We also improve the MOZART4 by considering the different aging time of BC across the world regions. We use tag technology to evaluate the long-range transport of BC. A deeper understanding of the direct and indirect long-range transport provides valuable insights with respect to mitigating long-range transboundary air pollution (LRTAP) and prompts concerted efforts aiming at more environmentally conscious globalization.

## EXIOBASE 3 - Construction and analysis of the world physical IOT

Topic: 514Z Special session: Compilation and Application of EXIOBASE 3 – a time series of highly detailed EE MRIOs
Author: Stefano MERCIAI
Co-Authors: Jannick Schmidt

This paper describes the main steps of the procedure for the construction of time series of Multi-regional hybrid units Supply and Use tables (MR-HSUTs) created as part of the EU funded project DESIRE.
The choice of unit in the HSUTs follow a hierarchical use of the units of measurement, i.e. all the tangible goods are accounted in dry matter mass, then the intangible energy flows in energy unit, and, finally, the remaining flows, mainly constituted by services, in monetary unit.

The tables are calculated from 1995 to 2011, for 44 main economies of the world, plus five rest of the world regions. 200 products and 164 activities are taken into account. In addition emission, resource, land, water and waste accounts are also derived. All the accounts are calculated respecting the mass balance within the activities, and between the supply and use of products.

As a starting point, the procedure uses data from the main global statistical sources (e.g. Eurostat, FAO, IEA, USGS, BGS, IPCC, etc.). In addition, monetary MR-MSUTs provided by the DESIRE partners play an important role. These data are used as base for the calculation of missing flows. A trade linking procedure is also part of the procedure.

The final result obtained is MR-HSUTs with homogeneous activities. This means that off-diagonal productions include only outputs that are technologically indivisible from the principal productions. Therefore, the calculated MR-HSUTs may be easily used as multi-regional input output table with the by-production technology (Stone's method). The only step to perform is an aggregation, or disaggregation, of some energy products to make the tables square.
In addition to the methodological aspects of the procedure, some elaborations of the calculated data set are shown. In particular, it will be shown the time series of carbon footprints for a basket of products .

## The contribution of foreign sourcing to changes in factor shares: a global structural decomposition analysis

Topic: 711Y Special session: Analysing Environmental and Economic Consequences of Globalisation Using MRIO-SDA
Author: Bernhard MICHEL
Co-Authors: Rutger HOEKSTRA, Sangwon SUH

Production patterns have changed substantially at a global scale over the past few decades. Prompted by technological developments and the opening up to trade of China and Central and Eastern Europe, production processes have become increasingly fragmented internationally. As a consequence, a growing amount of intermediates and also final goods are shipped between countries participating in ever more global value chains. A rapidly expanding literature analyses the value added captured by different countries in those global value chains using global multi-regional input-output data and models (e.g. OECD, 2013). Moreover, the emergence of global production patterns and value chains has an influence on the income shares of the different factors of production. As highlighted in Timmer et al. (2014), the income share of high-skilled labour has grown fastest in high-income countries at the expense of the income shares of medium-skilled and low-skilled labour, whereas in low-income countries the income share of capital has been increasing fastest. The aim of this paper is to analyse the contribution of foreign sourcing to these changes in factor income in both high-income and low-income countries and to compare it to the contribution of changes in production technology and final demand. The question is whether foreign sourcing really is the main driving force behind changes in factor shares in both high-income and low-income countries. For this purpose, we develop a global structural decomposition analysis (SDA) that isolates the contribution of foreign sourcing to the value added captured by the different factors of production in different countries. We consider foreign sourcing of both intermediates and goods and services delivered to final demand, and we split source countries according to average hourly wage rates. The data used for computing the decomposition come from the recently published World Input-Output Database (WIOD) in previous-year prices. This database contains global multi-regional input-output tables with 40 countries and 35 industries, and we specifically focus on the pre-crisis years 1995-2007.

# Does Income Inequality Increase Carbon Emissions? The cases of France and India

Topic: 711F  Inequality and Environment
Author: Jihoon MIN
Co-Authors: Narasimha Desirazu Rao

There is increasing interest in understanding the relationship between inequality and sustainability – does reducing income inequality trade-off higher resource use? How does this relationship differ at different stages of industrialization? Using a novel method of household energy footprinting using I/O analysis with uncertainty, we examine the implications of different patterns of income growth on energy use and carbon emissions.  We choose France and India as case studies to represent an industrialized and emerging economy respectively.

One recent study (Chancel and Piketty, 2015) asks a similar question, but at the global level. However, they use a hypothetical power law between household income and emissions, rather than calculating actual embedded energy footprints using I/O analysis.

Over the last few decades, several studies (Park and Heo 2007; Liu et al. 2009; Minx et al. 2013; Cohen, Lenzen, and Schaeffer 2005; Lenzen et al. 2006; Wei et al. 2007; Steen-Olsen 2015) have reported household energy requirements or carbon footprints for various countries. These papers, to various extents, may inform our question, since they sometimes indicate whether energy/carbon intensity of consumption increases or decreases with rising income. However, these studies are all deterministic despite considerable uncertainty in linking household consumption to I/O tables. Second, they make methodological simplifications or omissions that make their results unreliable and subject to unobserved biases. For instance, these studies do not allocate government expenditure (associated with social transfers) to household consumption, or account for different prices paid for similar commodities by different income groups.

In this study, we develop a randomized mapping and visualize uncertainties induced in the mapping process.

This study contains three methodological advances that allow for a more robust and accurate characterization of household energy and carbon footprints:

1)  Characterizing uncertainty in mapping consumer expenditure surveys (CES) to I/O tables: the mapping of consumption expenditure categories to industrial sectors requires knowledge production processes and pricing structure, which are not typically made available by national statistics offices. Hence, considerable number of assumptions have to be made. Instead, we first develop a qualitative mapping from consumption categories to sectors, and then assign probability distributions to allocation shares among them. We run a Monte Carlo simulation that constrains the random draws so that all allocations sum to 1 in each draw. We then visualize the range of uncertainty in results, as shown in the Preliminary results below.

2)  Allocation of ‘social transfers’ to households: We allocate government transfers for health and education to income deciles, because lower income groups tend to benefit disproportionately. We base the allocation of social transfers to household consumption for France on the 2003 breakdown estimates by income quintile (Insee 2003). For India (yet to be done) we plan to use available data on fossil fuel and electricity subsidies.

3)  Price adjustments: We have prices paid for most commodities in the household surveys. We

normalize these across income groups, so that energy footprints aren't artificially increased by price-induced increases in expenditure for the same product quantities. We focus on energy-intensive items, including food.

Since our main focus is on the global implication of consumption on energy, we adopt multi-regional IO data from the most recent EXIO project (CREEA) covering the year 2007. We select EXIO among other MRIO databases based on the fact that it has the largest number of harmonized commodity sectors (200 sectors) and an improved energy extension by sector with high resolution of energy carriers (Wood et al. 2014). We use the National Sample Survey 2011-2012 (68th round) for India and Household Budget Survey 2011 for France.
We base our qualitative mapping of India's CES to COICOP categories on a mapping suggested in an Indian governmental material (Verma 2014). For France, we use the mapping provided by EXIO.

## Trade in value-added, employment and productivity

Topic: 809E  Special session: SIC-OECD-IDE/JETRO Joint special sessions on Development, Employment and Inequality (3)
Author: Sebastien MIROUDOT

This paper contributes to a better understanding of the impact of global value chains (GVCs) and trade in value added (TiVA) on jobs and productivity by providing some initial evidence based on the OECD Inter-Country Input-Output (ICIO) database 2015, as well as employment data from the OECD and WIOD project, covering 45 economies. Different indicators are calculated to assess the number of workers involved in GVCs and the evolution between 1995 and 2011, based on a value-added approach that includes both the employees of exporting firms and the workers of all the domestic firms providing inputs to exporters. These figures are however still underestimating the number of persons involved in global value chains as activities of foreign-owned firms producing for domestic consumers are not taken into account.

Using different decomposition techniques, differences across industries (both the producing industry and the industry supplying inputs) are analysed, as well as patterns across partner countries. There are important differences across industries in the share of jobs embodied in exports. Services industries, for example, are generally less export-oriented. In addition, depending on the role of labour as an input in each industry, the same value-added exported can have a lower or higher job content in each industry. But when looking at the industry of origin of jobs embodied in exports, the actual contribution of the service sector is revealed. The jobs embodied in exports are either dependent on imports from the country's partners in the region (e.g. Mexico within NAFTA) or spread more evenly across partners in different regions (e.g. China or the United States). It depends on the position and specialisation of the country in the value chain. The jobs embodied in exports follow the general pattern of trade flows in value-added terms.

Further analysis is then conducted by matching the TiVA data with disaggregated occupational data by industry obtained from labour force surveys, thus giving new insights on the skill composition of the workforce involved in GVCs, as well as the main activities the workers are involved in (business functions). In almost all countries, the jobs embodied in exports are shifting towards high-skill and medium-skill jobs. There is also a similar pattern in terms of business functions, with fewer jobs in the core operations of firms (the manufacturing, processing and assembling activities) and more jobs in R&D, design, distribution, logistics, marketing, sales and

customer services. The famous ‘smile curve’ is empirically verified when looking at the change in employment by business function. There are however different patterns of specialisation when it comes to other support business functions such as IT services, administrative support, engineering and related technical services. Some countries are specialising in such business services while others have offshored part of them.

Finally, some econometric analysis is proposed to analyse the relationship between GVCs and employment at the industry level. No simple relationship between the participation in GVCs and the level of employment is found and the results suggest that as a consequence of the fragmentation of production, there is a specialisation of countries and a reallocation of workers not specifically across industries but in different activities in the value chain that can belong to different industries depending on the way firms are organised. In addition, GVCs have an impact on productivity and while some jobs are lost as a consequence of the offshoring of some activities, others are created, either within the same industry (which has become more productive and increased its output) or in other industries (through an income effect). The overall impact of GVCs on employment depends on the relative strength of these factors.

## The Digital Transformation of Manufacturing Industry - A Scenario Analysis for Germany

Topic: 814X  Structural Change and Dynamics
Author: Anke M. MOENNIG
Co-Authors: Marc Ingo Wolter

Looking back in time, the economy has been exposed to fundamental changes and transformation each induced by different factors: introduction of mechanical production facilities (first industrial revolution), electronic energy (second industrial revolution) or internet technology (third industrial revolution). Currently, the economy might be at the edge of a similar drastic transformation through the introduction of cyber physical systems (CPS). What is called in Germany “Industrie 4.0” or Industry of Things (IoT), describes the fusion between physical and virtual world in the production process through interconnecting men, machines, products, objects and internet and communication technologies.
Until today, in Germany, IoT is not yet realized, still unknown to a majority of small and medium sized enterprises and little evidence and expertise exist that is able to describe the impact of a digital transformation on the economy. This paper presents a first attempt to capture the economic effects of IoT on the economy in Germany in the long run.
A sophisticated scenario has been developed that addresses especially the following parameters: (i) gross fixed capital formation, (ii) change in inventory (iii) cost structure, (iv) supply chain and (v) private and state consumption, (vi) export. Using the macro-econometric input-output model INFORGE (Interindustry Forecasting Germany), these parameters are altered according to input taken from the literature, expert interviews and own expertise. The scenario assumes a slow transformation process that is realized not before 2025. The results are compared to a baseline scenario with no IoT assumptions.
The results indicate that a digital transformation of the economy leads to a higher growth path. The growth impact is accompanied with a decline in imports which is a positive side effect for a commodity-poor country such as Germany. However, additional growth comes along to the disadvantage of employment. Until 2025, a total of 10,000 jobs are lost. Albeit this is a small number, the digitization supports sectoral change: Especially the agriculture and manufacturing sectors lose jobs, whereas employment is generated in service sectors.

## The Hadamard-multiplicative GLS-based Model for Matrix Updating with a Solution Space of Reducible Dimension

Topic: 714B  Methodological Aspects of IO Analysis (2)
Author: Vladimir MOTORIN

The purpose of this study is to construct an operational Hadamard-multiplicative model for economic matrix updating within RAS method's multiplicative pattern of target matrix that can be represented as Hadamard's product of the initial matrix and a factor matrix of the same dimension formed by matrix multiplication of column and row vectors of unknown parameters. A natural way to generalize RAS pattern is to abandon its biproportional framework in favor of multiparametrical approach with the most common factor matrix. To satisfy row and column total constraints, one can disturb the elements of a factor matrix in some minimalistic manner that requires to be defined well.
According to RAS multiplicative pattern, all matrices from homothetic family of initial matrix have an excellent structural similarity. This feature allows to introduce the notion of a homothetic ray for vectorized factor matrix (directed by summation vector with unit elements) in multidimensional Euclidean space, whose dimension can be meaningly reduced by an elimination of those components that are corresponding to zero entries of initial matrix. Homothetic measure for matrix similarity is defined as a shortest path from unknown parametrical point (determined by vectorized factor matrix) to homothetic ray in GLS terms. Further, angular measure for matrix similarity is then defined as an angle between vectorized factor matrix and homothetic ray to be minimized. Note that both measures are geometrically conjugate and invariant with respect to a certain way of matrix vectorization.
It is shown that a minimization of angular measure can be implemented via the minimization of homothetic measure by solving the uniparametrical GLS-based mathematical programming problem with the quadratic objective function, two sets of the mutually dependent linear row and column total constraints, and scalar linear condition of orthogonal projecting onto a homothetic ray. This optimization model is fully represented in matrix notation, and its solution is obtained in analytical form that is further used in formulation and analytical solving the univariate unconstrained minimization problem for angular measure. Special attention is paid to sensitivity of optimal solution for homothetic measure to small changes in row and column totals of the target matrix (when the row and column total constraints are assumed non-binding).
Main advantage of the proposed model is its immanent flexibility because of great number of adjusting variables. The model is quite applicable for updating the economic matrices and tables with some negative entries. Several illustrative numerical examples are given.

## The Linear Matrix-Valued Cost and Production Functions in the Rectangular and Square Input–Output Models

Topic: 711B  Methodological Aspects of IO Analysis (1)
Author: Vladimir MOTORIN

A general linear problem of input–output analysis (GLP IOA) is considered in this study as a system of equations written in terms of free variables for any rectangular supply and use table given. This system spans the regular linear equations for material and financial balances, a batch of predetermined values for exogenous variables chosen in advance and an additional set of linkage equations that provides the exact identifiability for all unknown variables.
The study is concerned with some operational opportunities for constructing a set of the identifying linear equations in the cases of evaluating the response of the economy to exogenous

changes in final demand and value added vectors. To this end, it is expedient to involve into consideration a pair of the matrix-valued linear cost functions with product and industry outputs as their arguments respectively as well as the product-mix and market shares contours of supply (production) matrix. These four linear equations generate four different specifications of GLP IOA. On the other hand, one can consider a pair of the matrix-valued linear production functions with product and industry intermediate inputs as their arguments respectively as well as the product-mix and industry shares contours of intermediate consumption (use) matrix. As a result, the other four different specifications of GLP IOA arise.
It is shown that there are three main types of economy's response to exogenous changes in final demand and value added vectors while all of eight specifications are using for its evaluating, namely, in terms of volume changing exclusively, in terms of price changing only, and in terms of combined price and volume changes. The latter type of economy's response together with four associated specifications of GLP IOA seem to be implausible artefacts that are out of economic sense. In particular, there are some certain doubts about plausibility of underlying background for an industry technology assumption and a fixed product sales structure assumption, which are used in the transformation of supply and use tables to symmetric input-output tables.
The other four specifications of GLP IOA appear to be pairwise equivalent. First, the specification with linear dependency of intermediate consumption matrix from industry output vector (based on Leontief technical coefficients to be fixed) and invariable “vertical” (product-mix) structure of production matrix is equivalent to the specification with linear dependency of production matrix from vector of industry expenditures for intermediate consumption and invariable “vertical” structure of intermediate use matrix. Secondly, the specification with linear dependency of intermediate consumption matrix from product output vector (based on Ghosh allocation coefficients to be fixed) and invariable “horizontal” (industry shares) structure of production matrix is equivalent to the specification with linear dependency of production matrix from vector of product amounts in intermediate use and invariable “horizontal” structure of intermediate consumption matrix. Thus, technical and allocation coefficients should be regarded as helpful ways of economic interpretation rather than as operational tools for modeling.
It is shown that in a square case (when all matrices are square) the first pair of specifications forms an underlying algebraic framework of Leontief demand-driven model, whereas the second pair provides an algebraic foundation of Ghosh supply-driven model. For a symmetric (when production matrix is diagonal) square case, the equivalence of Ghosh supply-driven model and Leontief price model as well as the equivalence of Leontief demand-driven model and Ghosh quantity model are proved.

## Structural Change, labor market mismatch and Jobless Growth in Iran

Topic: 716X  Employment Analysis (2)
Author: Hadi MOUSAVI-NIK
Co-Authors: Sholeh BAGHERI PORMEHR, Afsaneh SHERKAT

In recent years, jobless growth has posed a major problem in many countries. Since 1990s, several economists have suggested structural factors may underlie this phenomenon. Looking at economic statistics of Iran shows that during 2006-2011 the employment rate is significantly reduced however the average annual economic growth rate is not significantly different from the previous, which shows the evidence of jobless growth. The main aim of this paper is to answer these questions: Do structural change- explain jobless growth in Iran? And if the answer is yes, what causes structural change- in this economy? For answering the first question, we use input-output decomposition approach. We also use 3 input-output tables (symmetric industry by

industry with industry assumption) for years 2001, 2006 and 2011 at constant price. Our initial finding shows that technology and labor productivity change components especially in manufacturing, transportation and communication and other service sectors are the main reasons of occurring jobless growth in this period. There are two important candidates for explaining why structural change happened in this period: Huge increasing of oil exports and skill mismatch in labor market. They both could guide the economy toward more capital-intensive activities. According to our initial investigation in labor market statistics, unbalanced efficient matching of skill- supply and demand in labor market may cause structural change.

JEL: C67, E24, E32,
Keyword: Input-output Table, Jobless Growth, Labor Market, Structural Change, labor skill mismatch.

## Introducing Carbon Taxes in Pakistan: A CGE Framework

Topic: 714C  Special session: Computable General Equilibrium Modeling for Policy Impact Analysis
Author: Zeshan MUHAMMAD
Co-Authors: Jong H. KO

Pakistan is one of the most vulnerable nations from climate change, which is visible in its changing crop cycle, monsoon patterns, severe weather events, and frequent natural disasters such as earthquakes and floods. Pakistan suffered the economic losses of around USD 15 billion during floods of 2010, 2011 and 2012. The severe flood in 2010 was the worst in Pakistan’s history, around 20 million people suffered and more than 300,000 people were displaced. In June 2015, the country was hit by severe heat waves which resulted in a loss of more than 1,500 lives. Just two months later, the severe floods devastated homes and the agricultural fields. The Climate Risk Index for 2014 describes Pakistan as the 5th most affected country in 2014. To overcome these vulnerabilities, the Ministry of Climate Change has challenging objectives. Goal of Pakistan’s climate change policy is to ensure that climate change has a mainstreamed position in the not only economically, but also socially vulnerable sectors of the country based on a climate resilient development. However, in the fiscal budget for the financial year 2016, the Ministry of Finance has allocated only USD 0.01 billion (0.02% of the total budget) for environment protection. With this inadequate environment protection budget, it looks impractical to secure such big ambitions set by the Ministry of Climate Change. Hence, the objective of this study is to reexamine Pakistan’s environment protection policy through micro and macro lenses. For this purpose, this study uses a modified version of the GTAP-E model to assess the potential economic effects of introducing carbon tax in Pakistan. The empirical results of carbon taxing include macroeconomic effects and microeconomic ones.

Keywords: Energy, Environment, Carbon tax, GTAP-E model
JEL Classification: C68, D61, P35, Q43

## The Impact of Trans-Pacific Partnership agreement on the Canadian economy

Topic: 514X  Special session: Economic Implications of Transpacific Partnership Agreement (TPP)
Author: Kakali MUKHOPADHYAY
Co-Authors: PAUL J. THOMASSIN

The Trans-Pacific Partnership is the most comprehensive trade agreement in the world. The TPP will help deepen Canada's trade ties in the dynamic and fast-growing Asia-Pacific region while strengthening existing economic partnerships with NAFTA partners and across Americas.

Despite the presence of many barriers to trade, Canada's exports to TPP countries averaged $366.1 billion CAD annually from 2012 to 2014. Industrial goods cover the major part of exports i.e. $311.4 billion CAD, followed by agriculture and agrifood ($30.9) and forestry and wood products ($20.4). The TPP will eliminate tariffs on almost all of Canada's key exports and offer access to new opportunities in the Asia-Pacific region. Tariffs and other barriers on a wide range of Canadian products from various sectors will be reduced, including in agriculture and agri-food, fish and seafood, forestry and wood products, metals and mining, and industrial goods. More importantly, the TPP will secure new market access opportunities for Canadian dairy, poultry and egg exports to the United States and all other TPP countries. TPP countries get duty-free access to 3.25 percent and 2.1 percent of Canada's dairy and poultry market respectively.

In this background, the current study evaluates the economic and environmental impacts of Trans-Pacific Partnership agreements on the Canadian economy by the year 2030 using a global CGE framework. This includes estimating the economic impact of the nation's industrial output, GDP, exports and imports and the resulting impact on welfare, labour growth and the environment. The study attempts a number of simulations based on the level of tariff reduction across selected commodities between Canada and other TPP Nations. The GTAP 9 Data Base with the reference year of 2011 is used for the study.

Results show that Canada stand to benefit significantly from improved access to the TPP region. Canada expects a considerable increase in the agricultural export. Canola, processed food and beverages, seafood, beef and pork sectors are expected to benefit from the deal. Industrial goods like farming and construction equipment, metal and mineral, motor vehicle as well as aerospace products would gain from TPP agreements. The agreement would help the economy to reach the goal of doubling Canada's manufacturing and exporting output by 2030. Further, banking sector is also expected to benefit from the deal.

## Renewable Energy Goals in the Philippines at 2030

Topic: 714Y  Special session: Economic and Environmental Impacts of Renewable Energy Targets in Asia
Author: Kakali MUKHOPADHYAY
Co-Authors: Krista Danielle Sy Yu

The looming effect of climate change continues to spur the development of alternative sources of energy. The development and optimal use of the country's renewable energy resources are central to the Philippine's sustainable energy agenda. Over the years, technology has improved the ability to harness energy from renewable resources. This will later on reduce an economy's dependence towards imports and contribute to domestic employment of labor and resources. The

Philippines registered an average renewable energy supply of 16.47 million tons of oil equivalent (MTOE) from 2000 to 2012, with an average share of 43.21 percent to the total energy supply. The largest producer of wind power, and the solar manufacturing hub in Southeast Asia, the Philippines envisions to be the world leader in geothermal energy with the country's untapped renewable energy potential (Philippine Development Plan 2011-2016). The geothermal energy accounted for the biggest share of 53.89 percent of the total renewable energy supply from 2000-2012, followed by biomass with 32.99 percent and hydro with 13.10 percent. The remaining shares were divided between solar and wind energies.

Renewable energy is an essential part of the country's low emissions development strategy and is vital to addressing the challenges of climate change, energy security and access to energy. The Philippines has one of the most comprehensive legislations for promoting renewable energy in the ASEAN region. On December 16, 2008, the Philippines enacted the Renewable Energy Act of 2008 to accelerate the exploration, development, and utilization of renewable energy resources in order to enhance the country's energy security, thereby lessening its heavy dependence on fossil fuels and reducing electricity rates. The Department of Energy launched the National Renewable Energy Program (NREP) on June 14, 2011, to achieve the goals laid down under the Renewable Energy Act of 2008. The NREP sets targets for solar, wind, geothermal, hydro and ocean technologies to 15,234.30 MW by 2030 from 5,439 MW in 2010 almost triple the country's renewable energy-based capacity. In this background, the current study makes an attempt to evaluate the economic and environmental impacts of the targeted Renewable Energy production in the Philippines using a Global Computable general equilibrium (CGE) framework. It applies the GTAP database of version 9.

Preliminary results show that an increase in gross domestic product (GDP), industrial output, and employment as a consequence of the additional production of solar, wind, geothermal and Hydro energy. It also contributes to nation's GHG emission reduction target. It is useful for assessing the country's progress in fulfilling its targets as well as its implications to various agents in the economy. The prospects for renewable energy development in the Philippines are promising. However, several challenges besetting the renewable energy sector have to be addressed to realize fully it's potential. These are: 1) high cost of renewable energy development due to a limited number of local manufacturers; 2) lack of capacity-building and training opportunities to enhance technical capabilities of stakeholders and potential developers; 3) need for stronger R&D on renewable energy; 4) limited infrastructure support.

## Counting borders in global value chains

Topic: 814Z  International Trade (3)
Author: Kirill MURADOV

It is widely recognised that the growing fragmentation of production across borders may have important implications for trade and investment policies. When value chains are global, intermediate inputs cross national borders multiple times as their value is carried forward from one production stage to another. Multiple border crossings involve multiple trade barriers and associated costs.

Although the measurements of global value chains are available and the analysis of their impact on trade, environment and jobs is now well established, little has been done to quantify the number of border crossings. A likely reason is that the existing accounting techniques have been developed to discover value added in gross trade flows. However, it is a product not value added

that physically crosses the border.

Specifically, the “global” Leontief inverse (or its Ghosh counterpart) is not suitable for the analysis of border crossings because it treats foreign intermediate inputs in the same way as domestic inputs. This paper addresses the said technical difficulty by introducing another “global” inverse that is capable of consistently delimiting domestic and international trade transactions. The new inverse is a key element in a gross exports accounting framework that traces the destination of direct exports to their eventual users through multi-stage production. The result is a measure of cumulative exports, delivered to the final users by mode of direct or indirect exports.

The power series of this multiplier matrix model a “melting” part of the initial exports until it is entirely consumed (used) at an infinitely remote tier. An indicator of the weighted average number of border crossings builds on the power series of the new “global” inverse where each term corresponds to a border crossing. It utilizes the logic of the average propagation length (proposed by Dietzenbacher, Romero Luna and Bosma in 2005) and the value added propagation length (explored by Ye, Meng and Wei in 2015). The proposed measure sums the number of border crossings weighted by the share of indirect exports at each successive tier (border crossing) in the cumulative exports at all tiers. Its lowest value is 1 when a sector only exports final products. This is in line with the conventional wisdom: exported products cross borders at least once.

For a numerical test of the proposed measure, the paper uses the inter-country input-output tables from the World Input-Output Database (WIOD) for 2001, 2005 and 2010. From the perspective of an exporting country (after sector-wise aggregation), the weighted average number of border crossings across all partners ranged in 2010 from 1.68 for India to 2.31 for Russia. The change in the number of total border crossings has not been uniform. For 20 exporting countries in WIOD, this number increased both in 2001-2005 and 2005-2010. For 19 countries, it increased in 2001-2005 but descended in 2005-2010. One country experienced a decline of this measure in both periods.

From the perspective of an exporting sector (after country-wise aggregation) in 2010, the products of the “Mining and Quarrying” industry had to cross more borders than any other product – 2.33, while the products of “Leather and Footwear” only crossed borders 1.24 times which was the lowest number (apart from the “Private Households with Employed Persons”).

Now, it is of significant analytical interest to check whether more border crossings have led to higher costs that accumulate along the value chain. For this exercise, the average number of border crossings is paired with the cumulative imports tariff, drawing on a combination of the WIOD and UN TRAINS data. It is confirmed that the indirect cumulative tariff rises with the average number of borders crossed. However, the continuous reduction of direct import tariffs neutralised the effect of the heightened number of border crossings in value chains in 2001-2010.

The measure of the average number of border crossings is thought to be useful for the studies of trade policies in the global value chain environment.

## Technological Unemployment in Mexico. An Analysis of Structural Decomposition

Topic: 716X  Employment Analysis (2)
Author: Brenda MURILLO VILLANUEVA
Co-Authors: Martín Carlos PUCHET ANYUL

It is known that the introduction of new technologies and techniques can lead to the displacement of workers, nevertheless, according to classical economics, there are several compensation mechanisms that enable to offset such negative effects. Therefore, the aim of this paper is to determine if the displacement effect is greater than the compensation effect or vice versa, or in other words, to determine if the net effect of the introduction of new techniques on the Mexican level of employment is positive or negative. For this purpose, the magnitudes of the displacement and compensation effects will be measured through the structural decomposition of two pairs of employment matrices that were built utilizing the Mexican Input-Output tables of 2002, 2008 and 2012 reported by the Mexican Office of Statistics (INEGI). The findings suggest that the net effect of the technical change on the Mexican level of employment is negative and that there are sectors such as chemical industries, basic metals and machinery and equipment in which the displacement effect is considerably higher.

Keywords: technological unemployment, displacement effect, compensation effect, structural decomposition.

JEL Codes: O33, C67, J23

## Identifying Air Pollution Clusters within Asian Supply Chain Networks

Topic: 811F  Network Analysis for Environment
Author: Fumiya NAGASHIMA
Co-Authors: Shigemi Kagawa, Keisuke NANSAI

Asian countries use a large quantity of fossil fuels in the production of goods, generating substances that are a major cause of air pollution. The fine particulate matter (PM2.5) emitted by the production activities of China are a problem not only because of their adverse health impact within China but also because they give rise to cross-border pollution in neighboring countries. Regarding this air pollution problem, research aimed at developing emission inventories of air pollutants in the Asia region has been carried out in recent years (e.g., Ohara et al., 2007). However, the emission responsibility has not been clearly discussed in the context of life-cycle management and emission reduction policy. With this background, this paper proposes a new spectral clustering framework based on the supply chain network extending from final demand to producers and even considers cross-border pollution of other countries (e.g. Kagawa et al., 2013). Based on the environmentally-extended multi-regional Asian input–output table for 2005, we identified environmentally-important supply chain clusters with higher PM2.5 emissions and health impacts in the Asian countries. We found the following: (1) the supply chain clusters with the greatest impact on human health in the Asia countries are centered around agricultural clusters in China (e.g., “Paddy”, “Other grain”, and “Food crops”), (2) the transportation sector also plays a major role in air pollution, as a hub of supply chain clusters that generate relatively large impacts on human health. This paper concludes that the emission reduction measures in higher priority clusters centered around agriculture and transportation sector in China and South

Korea are crucial in reducing human health impacts associated with supply chains in Asian countries.

## Determination of relative prices

Topic: 711D  Productivity and Efficiency (1)
Author: Akiko Nakajima

Question asked is whether cost measured in terms of all total labour cost has tendency to determine long run relative prices. All total inputs including capital costs are measured in labour producing each inputs, or capital goods constituting capital formation. This treatment of measuring total labor costs are novel, or new. According to Japanese IO data for the past 50 years,  from statistical office and rieti data, weighting by total outputs of each industry indicates that relative prices are determined by total labor costs in a long run.

## The Environmental Consequences of Lifetime Extension of New and Used Cars:  Japan's Case

Topic: 811Y  LCA and Industrial Ecology (1)
Author: Yuya NAKAMOTO
Co-Authors: Daisuke NISHIJIMA, Shigemi Kagawa

Global Warming has become more serious in our society, and Japan tries to reduce CO2 emissions. In Japan, the transportation sector occupies 17.1% of the total amount of CO2 emissions of Japan in 2012 (Ministry of Land, Infrastructure, Transport and Tourism, 2013). The CO2 emissions in the transportation sector have increased due to the increase in the transportation volume during 1990 to 2012 (Ministry of Land, Infrastructure, Transport and Tourism, 2013). The Japanese government has introduced a vehicle replacement scheme to replace older cars with lower fuel efficiency with new cars with higher fuel efficiency and attempted to reduce CO2 emissions from the transportation sector.

With this background, Kagawa et al. (2013) propose an environmental impact assessment method for assessing the effectiveness of scrappage schemes for reducing CO2 emissions taking into account the rebound effect, driving behavior for older versus new cars and entire lifecycle emissions for during the manufacturing processes of new cars. They found that CO2 emissions would only decrease if users of the scheme retained their new gasoline passenger vehicles for at least 4.7 years. However, their assessment framework did not consider the vehicle lifetime and market of 'used cars' and therefore they ignored life-cycle emissions of reusing older cars as used cars.

This study considers the vehicle lifetime and market of both new and used cars and develops an automobile life-cycle input-output framework considering lifetime of used cars. We used the car sales data during 1993 to 2014 (Japan Automobile Dealers Association, 2014), 2005 environmental input-output table (National Institute for Environmental Studies, 2010) and parameters of the vehicle lifetime density function estimated by Kagawa et al. (2011). We addressed the following question of how the market expansion and lifetime extension of used cars affect life-cycle CO2 emissions through the entire economy. The results show the following. Under the benchmark lifetime function, a 10% increase in the market share of used cars yields the reduction in the cumulated life-cycle emissions during 1993 to 2014 amounting to 80 million

tonnes-CO2. We found that modifying this policy with a focus on subsidies of used cars with higher fuel efficiency, and setting the target car age of used cars, would increase environmental benefits.

## Technological Contents of China's Exports and Its Dynamic Changes----a New Measure based on global input-output model

Topic: 809B Innovation and Technological Transfer
Author: Hongfu NI
Co-Authors: Jiechang Xia

Since the 90s of twentieth Century, the scale and structure of China's exports have changed dramatically, and the export of goods has increased from 148.78 billion US $ in 1995 to 2209.00 billion US $ in 2013, the average growth rate of 1384.75%. According to the traditional gross trade statistics, the proportion of China's high-tech products exports increased continually, and the structure of export upgrades significantly. Based on the measures of technological complexity proposed by Lall, most of the studies show that the technological content of China's exports has increased significantly and the level of technological complexity exceeds its income level ( Lall, et al ,2006;Rodrick,2006; Hausmann et al, 2007).

However, all the methods above neglect an important feature of the rapid economic globalization in recent decades, that is the rise of global value chains(GVC□□Goods that a country exports are not produced completely by the country. A country's export products are manufactured by use of foreign intermediate inputs, and the technological content of export products does not completely come from the export country. A scientific methods to measure the technological content of export should not based on the product in the traditional method, but on production process. Lall et al. (2006) pointed out: "the technological complexity is actually affected by a variety of non technical factors, rather than the specific technical measures." Especially, they also point out: "a measure of the technological content of exports requires the production process data, rather than the data of the gross product, but it is difficult to obtain the data about the production process." That is to say, measuring the technological content should be based on the specific production stage of the task / activity , that is the production process.

Therefore, this paper tries to establish a new method to measure the technological content of export products based on the production process by using the global input-output tables (1995-2011) from WIOD. The new method is similar with the literature of value-Added trade methods. The overall technological content of export is divided into domestic technological contents and foreign technological contents in our new measure. our preliminary results show that: First, since 1995, the technological level of China's export indeed have been upgraded and optimized. The overall technological contents, domestic technological contents and the index of domestic technological contents of the overall exports or the individual sector's exports have risen since 1995. the index of domestic technological contents of China exports have risen from 0.26 in 1995 to 0.55 in 2011. Therefore they are converging to the average level of the world. Second, compared with developed countries such as USA ,Japan , the technological content of China's export products is extremely low and locked in the most low-end. Therefore ,it is difficult for China to threat the advanced technology position of developed countries such as USA, Japan.

# Product Lifetime, Energy Efficiency and The Environment: A Case Study of Air Conditioner in Japan

Topic: 814Y  LCA and Industrial Ecology (2)
Author: Daisuke NISHIJIMA
Co-Authors: Shigemi Kagawa

Based on residential sector electricity use in 2009, residential air conditioners are the fourth largest source of consumption, which also means that they are a major source of CO2 emissions. Moreover, future CO2 emissions caused by using air conditioners increases drastically because of global warming. Air conditioners will play a more important role in CO2 emissions in the future.

The energy efficiency of residential air conditioners has greatly improved in recent years as a result of the increased efficiency of compressors and heat exchangers. More recently, however, the energy efficiency of air conditioners has improved only marginally, as their technology approaches its limits.

Even as efforts to improve the energy efficiency of residential air conditioners face technological limitations, the reduction of CO2 emissions remains an urgent task. In addition, the environmental concerns of consumers continue to mount. In light of this, replacement purchases of new air conditioners do not promise any significant gain in energy efficiency, so from both economic and environmental viewpoints, consumers have an incentive to continue using their current air conditioners for a longer time. This results in fewer replacement purchases of new air conditioners and less quantity of CO2 emissions generated in the production phase of residential air conditioners. On the other hand, when old air conditioners are retained for a longer time, replacement purchases of new higher efficiency models are delayed, resulting in higher CO2 emissions in the use phase. Thus, in considering how a longer use of residential air conditioners affects CO2 emissions, there is a trade-off between CO2 emissions arising from the production phase and those arising from the use phase. Proceeding studies showed CO2 emissions induced by air conditioners with a variety of methods. However, they could not construct models for product lifetime and trend of energy efficiency of air conditioners and analyze the impact of those changes on life-cycle CO2 emissions simultaneously.

With this research motivation, this study proposes an integrated environmental input-output model that simultaneously considers both the lifetime of residential air conditioners and their energy efficiency (electricity consumption) for analyzing the influence of lifetime and energy efficiency on life-cycle CO2 emissions. The stock and flow of durable goods was modelled by the Weibull lifetime distributions and the trend in annual energy efficiency (i.e., annual electricity consumption) of an “average” durable good was formulated as a reverse logistic curve including a technologically limit value (i.e., limit energy efficiency) with respect to time. Utilizing this model, we can examine the potential for reducing CO2 emissions not only by changing the average lifetime but also by improving the energy performance of air conditioners.

The results indicate that further reducing the electricity consumption of air conditioners is essential for continuing to cut the total CO2 emissions resulting from residential air conditioners. To promote such technological progress, it is important to adopt policies and initiatives that encourage the purchase of highly energy-efficient products, such as vehicle scrappage schemes introduced in various countries. Such measures serve not only to reduce the lifetimes of products but also to improve their energy efficiency.

One important question is how much the energy efficiency of new air conditioners needs to be

improved in order to offset the increase in production-phase emissions that occurs due to the additional new air conditioners resulting from a shorter average lifetime. Even at the reduced average lifetime by 1 year, if air conditioner energy efficiency can be improved by 3.6% from the current level, CO2 emissions can be reduced by approximately the same amount as when the average lifetime is extended by 1 year(at the current energy efficiency). If air conditioner energy efficiency is improved further to 5%, 10%, and 15% below the current level, it is possible to achieve CO2 emissions that are lower than those when the average lifetime is extended by 1 years.

The model proposed in this study not only estimates the CO2 emissions derived from residential air conditioners but also offers a target value for energy efficiency that indicates the degree to which energy-saving technology needs to be improved.

## Structural Propagation of Productivity Shocks: The Case of Korea and Japan

Topic: 714A  Special session: Competitive and Complementary Economic Relationships between Korea and Japan
Author: Kazuhiko NISHIMURA
Co-Authors: Jiyoung KIM, Satoshi NAKANO

We model the transition of technological structure that is associated with the changes in cost induced by the innovation that occurred, using a system of multi-sector, multi- factor production functions. Structural propagation is quantified by using a system of unit-cost functions compatible with multi-level CES, plain CES, Cobb–Douglas, and Leontief production functions whose parameters we estimate via two timely distant input–output accounts. The economy-wide welfare gain obtainable for an exogenously given innovation will hence be quantified via the technological structure after structural propagation. Welfare gain due to productivity shocks is studied as an example, using the 2000–2005 Korean linked input–output table, as well as the 2000–2005 Japan linked input–output table as the source of data.

## A Hypothetical Supply Chain with the Disruption of Production Shock: From HEM to Hypothetical APL

Topic: 811B  Disaster Analysis
Author: Michiya NOZAKI

This paper develops a methodology to predict the economic impact of major catastrophes, such as earthquakes and tsunamis, by means of the hypothetical extraction method and hypothetical average propagation lengths. The methodology is tested by means of a comparison of the pre-disaster regional economy (base scenario) with a series of post-disaster regional economies (scenarios with regional production shocks) to the Japanese inter-regional, inter-industry economy. Then, we can compile nine hypothetical I-O tables with post-disaster cases with the Japanese interregional economy. Besides, we can also analyze nine hypothetical average propagation lengths. Finally, we share our conclusion, considering the policy implications on the relation between the economic recovery after the major catastrophes and our results.
Keywords: catastrophe analysis, hypothetical extraction method, supply chain, hypothetical average propagation length, disaster.

## Development of Inter-industrial Metal Network with Input-Output based Material Flow Analysis

Topic: 811Y LCA and Industrial Ecology (1)
Author: Hajime OHNO
Co-Authors: Wei-Qiang CHEN, Thomas Graedel, Philip NUSS

Metals have strongly contributed to the development of the human society. Today, large amounts and various metals are utilized in a wide variety of products. Metals are rarely used individually but mostly together with other metals in the form of alloys and/or other combinational uses. While combinational uses of metals provide a lot of useful properties for materials, they tend to make recycling of end of life metal scrap more complicated to be separately recovered. For sustainable use of metals resources, current circumstance of metal uses and their combination should be well understood and quantified.
This study reveals the inter-sectoral flow of metals by means of input-output (IO) based material flow analysis (MFA). Using the 2007 United States IO table, we calculate the flows of eight metals (i.e., manganese, chromium, nickel, molybdenum, niobium, vanadium, tungsten and cobalt) and simultaneously visualize them as a network. We quantify the interrelationship of metals by means of flow path sharing. Furthermore, by looking at the flows of alloys into metal networks, the networks of the major metals iron, aluminum, and copper together with those of the eight alloying metals can be categorized into alloyed-, non-alloyed-(i.e. individual), and both mixed.
The result shows that most metals are used primarily in alloy form and that functional recycling thereby requires identification, separation, and alloy-specific reprocessing if the physical properties of the alloys are to be retained for subsequent use. The quantified interrelation of metals helps us consider better metal uses and develop a sustainable cycle of metals.

## Disaster Impact Analysis: Environmental Considerations?

Topic: 814B Special session: Disaster Impact Analysis
Author: Yasuhide OKUYAMA

Disaster, as the consequences of a natural hazard, poses a wide range of impacts in the human society and economy. Ever increasing severity and intensity of natural hazards also threaten the environment where the human society and economy relies on the natural resources and the ecosystem where we live in. The current emphasis of disaster impact analysis has been on the socio-economic aspects; however, the social and economic activities are certainly interlinked with and are influenced from the changes in the surrounding environment. The natural environment is closely linked with both society and economy, or vise versa. And, the interrelationships between the natural environment and the economy through natural resources, quality of life, pollutions, regulations, among other things, have been studied in numerous ways, especially in the context of climate change. By the same token, disaster is tightly interwoven with the natural environment and the economy in the disaster management context. And, the impacts of disaster on the economy have been studied on many different aspects, ranging from microeconomic issue of supply chain management to macroeconomic concern of financing reconstruction projects. In contrast, little attention has been paid to the integrative analysis among these three constituents, “particularly at the local levels” (Tran and Shaw, 2007). In this paper, the framework for extending disaster impact analysis to include the impacts on and from the natural environment is examined. The potential uses of the ECLAC methodology for the input data and of the environmentally extended social ac-counting matrix for the estimation methodology are reviewed and discussed, and the future directions are suggested.

## Identifying critical value chains in CO2, energy, material, monetary and employment consumption-based accounts

Topic: 811F  Network Analysis for Environment
Author: Anne OWEN
Co-Authors: John Barrett

The majority of the UK's CO2, energy and materials consumption-based account (CBA) can be accounted for by identifying the largest 100 value chains. It is logical to propose that emissions reduction and energy and material efficiency policies should focus on these most important supply chains. Different policy levers target different parts of the value chain, for example, reducing final, and or intermediate demand or improving the efficiency of industry. Ideally these policies, whilst reducing environmental impact, should preserve the socio-economic wellbeing of both the UK and her trading partners. This paper uses structural path techniques with a UK focussed multiregional input-output database to identify the most important environmental value chains. We then review policy levers that could reduce the UK's CO2, energy and material CBA. Finally we refine the list of value chains to remove those which are critical to the economies and employment base of the UK and the rest of the world.

## Towards a better understanding of consumption-based energy accounts: a comparison of MRIO results calculated from different energy extensions

Topic: 514Y  Energy IO Modelling (1)
Author: Anne OWEN
Co-Authors: John Barrett, Lina Isabel Brand Correa, Marco Sakai

The International Energy Association reports each country's energy balance by energy supply tracing this through to total final consumption by industry, transport, non-energy use and other. This approach, while useful at a territorial level, does not account for the role of final consumers as drivers of energy supply. Input-output (IO) analysis can be used to reallocate energy associated with industrial sectors to products purchased by final consumers. This approach takes into account energy associated with the full supply chain of products, including those parts of the production process taking place abroad. Using IO techniques to understand energy flows within an economy is not a new technique but previous studies have been limited to single region IO tables. Recently, a number of multi-regional input-output (MRIO) databases have been developed which have allowed a better understanding of the role of traded goods in a country's emissions consumption-based account (CBA). The purpose of this paper is therefore to extend the MRIO approach to energy accounting.

This paper presents an MRIO framework for calculating the UK's energy CBA, and explores the implications of using different energy vectors alongside economic data taken from EXIOBASE. We compare results calculated using four energy vectors as inputs to the MRIO database: production; total primary energy supply; total final consumption; and total final consumption including losses, energy sector own use and bunker fuels. In addition we discuss the issues of using monetary data as a proxy for energy flows, and present an alternative mixed unit technique for better representing flows of energy within the economy.

This paper concludes by discussing the most appropriate vector to use for different types of energy research question.

## Accounting for technology, trade and final consumption in employment: an Input-Output decomposition

Topic: 711X  Employment Analysis (1)
Author: Mathilde PAK
Co-Authors: Aurélien POISSONNIER

What are the driving forces of changes in employment in France over the last thirty years and how can we explain skill-bias changes in employment?

Based on an Input-Output analysis we provide a decomposition of changes in employment between the effect of final consumption, technology and trade. Our goal is to assess these effects on employment by skill level (expressed in terms of headcounts). We measure skill level based on the occupational classification data available in the French Labour Force Survey.

Few papers in the literature take into account the effects of these three channels altogether. However a part of this literature does so using Input-Output analysis. Our analysis builds on textbook methodologies of structural decomposition, but innovative data: Input-Output tables both in current and previous year prices, from 1980 to 2010 based on the new ESA 2010 concepts. The Input-Output approach we develop is nevertheless limited as it cannot reveal long term underlying links between technology, trade and final consumption. This approach captures what we may call first round, short term or partial equilibrium effects. It is however informative as it provides a comprehensive evaluation of these first round effects altogether.

Unlike previous works on the US, the UK and some European countries, we find no evidence of labour market polarization. However on a short-term basis, we find skill-bias effects of technology on employment, whereas trade and final consumption have limited skill-bias. The development of high-technology manufacturing and R&D over the last thirty years contribute the most to this skill-biased technological changes. Quite strikingly trade's overall effect on employment is positive for every level of skill.

## The value added of introducing heterogeneous technologies in CGE models with implications on trade liberalization

Topic: 711W  Special session: APEC TiVA: SUTs with Firm Heterogeneity (1)
Author: Jiansuo PEI
Co-Authors: Cuihong YANG

Conventional CGE models for Chinese trade policy analysis do not differentiate processing export and the rest of the Chinese economy. Examples include the model developed by China’s Development Research Center (the DRC model), which focuses on the Chinese regions, and the standard GTAP model (Hertel and Tsigas 1997). Economists have attempted to separate normal and processing trade in a CGE model for China (Ianchovichina et al. 2000, Wang 2003, Ianchovichina 2004, Ianchovichina and Martin 2004). Recently, with the availability of Chinese trade data on processing trade, Koopman et al. (2013) is able to split the processing trade sector and treats it as a separate economy in a GTAP-turned GVC model. The split, however, is largely based on assumptions on key input-output coefficients and does not further differentiate the normal export and domestic production types.

DPN IOT, a tripartite input-output table was pioneered by Chen et al. (2001) and Chen et al. (2012) and in 2012 was designated as China's official participating project in the WTO/OECD

"Made in the World" initiative. Therefore, it has good real data support in splitting the three parts. Based on 2010 DPN IOT, a tripartite CGE model known as DPN GEM was developed to study trade growth impacts of China's structural reforms (Pei, Yang and Yao, 2015).

Our proposed modeling work is an improvement along this line and it is made possible through construction of a tripartite social accounting matrix (DPN SAM). This DPN SAM, including a DPN IOT and with 2012 as its base year, constitutes the database for an upgraded ORANI type China CGE model, i.e. the DPN GEM. We will test the model with a policy exercise, which shows the strengths of incorporating heterogeneous technologies in CGE models.

## Carbon Footprints and Household Consumption Pattern in India: A SAM Based Analysis

Topic: 811D Special session: Modeling Impacts of Structural Change in Emerging Economies (2)
Author: Radhika PIPLANI

The discussions at the Paris Climate Summit to limit the temperature rise to 1.5$^{o}$C above pre industrial level makes it imperative for countries dependent on oil, coal and gas to find alternative sources of energy. At present, India shares lesser obligations for such a high target; however, it is not quite far when some stern measures would have to be taken by the political leadership. India, being one of the fastest growing developing economies, has recently opened its door to foreign investment in technology and infrastructure. Such measures necessitate actions to curtail the influx of carbon emissions. With growing need and demands of the household sector, there is ought to be increased energy consumption through services like transport, electricity, construction, agriculture and allied activities, durables amongst others. This aggravates the capacity of the carbon sink through increased carbon footprints. The situation has not been accounted for adequately in India's 12th Five Year Plan (2012-17). With limited number of empirical studies undertaken for India in this domain, this particular research paper tries to overcome the research gap and directs attention to pertinent policy questions.

In this study it is shown how the latest available Social Accounting Matrix of India (SAM) can be used to enumerate the direct and indirect carbon emissions required to satisfy a given consumption demand by the household sector. The 78 sector SAM is modified to 16 broad sectors on the basis of end use by the household sector and relative homogeneity along the technological lines. The emphasis has also been given to the manufacturing sector keeping in context with India's changed political ideology. The broad sectors identified in the study are agriculture and allied activities, coal, natural gas, petroleum, mining, textiles, durables, chemicals and fertilizers, cement, non metallic products, metals, machinery (capital goods), other manufacturing, construction, electricity and services. The energy sector has been kept at a disaggregated level through sectors like Coal, Natural Gas and Petroleum. This study makes use of the emission coefficient by fuel type for Coal, Natural Gas and Petroleum to calculate the emission intensity per unit of output demand. The three factors of production land, labour and capital have been divided into labour and non labour component while the households have been disaggregated according to rural and urban areas. Private Corporation, Public Enterprises, Government, Net Indirect Taxes, Capital Account and Rest of the World have been kept exogenous in the study. In this study we derive the fixed price multipliers on the basis of the assumption of excess capacity which keeps the prices constant. Through the SAM framework the exogenous shock in terms of increased household demand will determine the carbon footprints of per unit output demanded.

Key Words: Carbon Emissions, Household Sector, Consumption, Social Accounting Matrix

## Evaluating deep decarbonization impact on productivity and growth

Topic: 516E  Enviromental Analysis for Development (2)
Author: Andrey POLBIN
Co-Authors: Oleg LUGOVOY, Vladimir POTASHNIKOV

With the new Paris climate agreement 195 nations agreed to lower planet-warming greenhouse gas emissions and try to avoid growth of earth temperature higher than 2C, with a target 1.5C. This goal requires that every country should radically cut their emissions, i.e. deeply decarbonize their economies, rebuild both energy supply and use sectors. Even bigger challenges meet natural resources exporting countries, which have to reshape not only their energy sectors, but also find a new sources for growth, grow new businesses to replace revenues from energy export. Here we consider several impacts of deep decarbonization policy on an economy, productivity and growth. First, the action requires higher level of investments. Low- and zero-carbon technologies, many of which are already cost-competitive with traditional fossil-fuels-based techs, are normally having higher investment costs, but zero (or low – for biomass) fuel costs. Therefore decarbonization demands higher investments upfront, unlike traditional fossil-fired technologies. The second important change is a downshift in energy use, as a result of energy efficiency improvements and rise of share of renewable energy in total primary energy consumption.
As participants of Deep Decarbonization Pathways Project (DDPP, by UNSDSN), the authors use outputs of DDPP scenario modeling, based on “Bottom-Up” technology choice models, as an input to the analysis and perform a “thought experiment”, estimating the impact of low carbon scenario on economy. We use three different models for the analysis: basic input-output (IO), computable general equilibrium (CGE), and overlapping generation (OLG) endogenous growth models to evaluate structural shifts, and changes in potential growth of Russian economy as result of deep decarbonization policy.
The results suggest several positive effects, including growth of machinery and high-tech sectors, reduction of importance of natural resource extracting sector, higher demand on R&D and skilled labor, overall employment growth, and higher potential of economic growth. All the effects are completely agreed with acclaimed by the Russian government strategic targets of long-run development: diversification and modernization of the economy, reduction dependence of the economy of natural resource export, improving the role of innovation and R&D in long-run economic growth and development.

## Using consumption-based emissions for policy analysis: the difference between average and marginal consumption-based emissions

Topic: 516F  Environmental IO Modelling (2)
Author: Hector B. POLLITT
Co-Authors: Richard WOOD, Umed TEMURSHOEV, Simone SALOTTI, José M. RUEDA-CANTUCHE, Eva S. ALEXANDRI, Annela ANGER-KRAAVI

The methodology for estimating CO2 and greenhouse gas emissions on a consumption basis, using a combination of input-output and bilateral trade data, is now well established. Several previous studies have used the approach to allocate historical emissions to the consumers of final products, typically showing that the US and Europe account for a larger share of total global emissions when measured on a consumption basis.

While the method provides a robust way with which to allocate historical emissions, it is not able to suggest policies which could be used to reduce a country's consumption-based emissions. For this we must turn to macroeconomic models and a scenario-based analysis. We find that, as the macroeconomic models relax some of the relatively fixed assumptions in standard IO analysis (e.g. constant returns to scale, fixed trade shares), we can estimate marginal changes in consumption-based emissions resulting from policy using the endogenous IO tables in the models. Furthermore, the difference between marginal changes and the average changes that have been estimated previously can be quite large.

The paper uses the results from a large number of simulations from two macroeconomic models (E3ME and Fidelio) to illustrate the issue. In both cases unit shocks are applied across a range of final products in the models to estimate the marginal changes in emissions. The results are compared to the average changes in emissions that are estimated using the standard approach.

The final section of the paper discusses the potential implications for policy makers and how they should interpret the model results, with the aim of developing the concept of consumption-based emissions to something that is more useful in the policy formation process.

## Increasing women's access to newer opportunities: A multi-year Indian SAM analysis for women's work

Topic: 811D Special session: Modeling Impacts of Structural Change in Emerging Economies (2)
Author: Avantika PRABHAKAR
Co-Authors: Anushree SINHA

It is recognized that women work under harder conditions mainly in developing countries and most of their work is not marketed. At the same time such non-marketed work supports in building both human capital and in subsiding public expenditure on welfare goods. The major barrier that women face which prevents them from competing in market work is "care work" which involves over-burdening domestic duties. Moreover, this work is unpaid and unvalued which implies that women involved only in care work are "invisible" in economic terms. In this paper we develop two Social Accounting Matrices (SAMs), one for the year 2003-04 and one for 2009-10. The SAMs will incorporate non-market work for women by generating a shadow value-added by using minimum wages for labour (for first order approximation) by imputing remuneration or from data, whichever is possible. To make gender aware analysis useful to policy makers so as to make a difference to the well-being of women, innovation is necessary in evolving models that recognize behavioral differences by gender. As a first step we will attempt to identify all kinds of work carried out by women, which comprises both work in the market as well at home, describing the latter as "non-market work". In a national accounting framework, work needs to be linked to value-added and to overall GDP. Market work is linked to value added and GDP through wages. We recognize that non-market work has no visible wages and so it is difficult if not impossible to measure it. We quantify such work by the imputed value method as noted above.

The SAMs will have nine sectors: (1) Agriculture (2) Mining and Quarrying (3) Agro Processing (4) Other Manufacturing (5) Ready-made Garments (6) Capital Goods (7) Construction (8) Other Services (9) Public Administration. These sectors have been dis-aggregated based on the industries that women are typically more involved with. The SAMs will analyse 20 types of households: according to work status, seven types each for male and female (Own Account Worker, Employer, Unpaid Family Worker, Regular Employee, Casual Labour in Public Activities,

Casual Labour in Other Activities and Non-market Work) and based on MPCE levels, three types each for rural and urban households. The data sources which will be used for the study are (1) the all-India Input-Output Tables for 2004-05 and 2007-08 (updated to 2009-10) published by the Central Statistical Office in India; (2) National Accounts Statistics for both years to use control totals for sector production, value added, savings for households, government transfers, household consumption, government consumption, capital, remittances; (3) the National Sample Survey Office's (NSSO) survey data rounds on Household Consumption Expenditure and Employment and Unemployment for 2004-05 and 2009-10 (61st and 66th rounds) to estimate consumption and employment patterns across households and workers and to also get estimates of non-market work (The NSSO is an organization under the Ministry of Statistics conducting socio-economic surveys of representative samples in the country. The survey period usually extends from July to June.); (4) Indian Government Budget documents for subsidies and tax revenues; (5) Census 2001 and 2011 for estimating actual number of workers by sector for the two study years; and (6) Indian Labour Bureau Publications for minimum wages by type of economic activity.

The paper attempts to find the possible demographic dividend of women's workforce participation. We recognize that policy changes are likely to have differential impacts on women. We use models that allow macro policy analysis with a gender perspective to conduct various simulations. Specific policy variations would be run on the two SAMs to understand how an external trade or tax shock would create demand for women's market work and impact non-market work. The major policy alternatives would provide alternatives with different entities replacing the non-market work by women. We would also analyse the impact of women substituting non-market work with market work with equal wages on the economy. Also, we would examine higher government expenditure helping women.

## Convergence of Demand Pull into Cost Push Inflation in Indian Economy

Topic: 516A Financial Analysis
Author: Shri PRAKASH
Co-Authors: Sudhi Sharma

Inflation has been the perennial problem world over since times immemorial. But the Indian economy had been experiencing periodic inflationary pressures even before the problem became endemic in the developed countries. Besides, the genre of inflation in Indian economy is different from that of the developed economies. Reason is that inflation in Indian economy has not been a monetary phenomenon at any time. The economy had been experiencing famines due to periodic crop failures, resulting in the high rise in prices of agricultural goods in general and food grains in particular. The rise in food prices are accounted by sudden shortages of supplies of essential goods. Thus, inflation does not emerge in all sectors simultaneously which occurs due to exceptional rise in money incomes. The demand pull inflation in Indian economy is, therefore, not the consequence of increase in demand due to excess supply of money in the economy; the excess demand is the result of supplies falling short of demand for good and other agricultural goods, even though monetary incomes and quantities of demand might have remained constant. This feature of the economy has not changed much despite seven and half decades of the growth of the Indian economy and structural changes associated with growth.
The paper has evolved four input output models to empirically examine the problem in alternative ways and also to compare the results furnished by different models. The paper also focuses on the evaluation of the stability of elasticity coefficients of fix-prices with respect to the

observed and hypothetical changes in flex prices in the economy.
Two of the four I-O models are integrated ones and rest two models are decomposed I-O models. Changes in flex prices are treated as exogenous to the system, though both flex price sectors (41) and fix price sectors (89) are an integral part of I-O models.
The thrust of the findings is that the monetary policy followed by India in recent years, which is patterned on the policy of developed economies, has been a failure to contain what to say mitigate inflation due to its irrelevance to the structural features of the economy and the root cause underlying inflation. Inflation in Indian economy is structural rather than monetary.

(1) Research Questions
1.1 Is Inflation in India is Monetary or Structural phenomenon
1.2 From which sectors Inflation originates in India
1.3 Is RBI following Policy which addresses the genesis of inflation in Indian Economy
1.4 What is the impact and spread of changes of flex/agricultural prices on fix/non agricultural prices
1.5 Is Demand pull Inflation necessarily a monetary phenomenon in economies like India
1.6 What is the degree and direction of responsiveness of fix prices to changes in flex prices

(2) Method Used:
2.1 Four Input Output Models- two are decomposed and two are integrated

(3) Data Used:
3.1 Input Output Table of CSO 2008
3.2 Data relating to flex prices of 20011, 2012 and 2013

4. Novelty of the research
4.1 The mechanism of conversion of demand into cost push inflation in Indian Economy
4.2 Estimation of coefficients of elasticity of fixed prices with respect to changes in flex prices
4.3 Evaluation of stability of point elasticity and their convergence to arc elasticity.

## Brazil and Mexico: Relative advantages of the trade with Asia vis a vis those with MERCOSUR and NAFTA

Topic: 716D  Special session: Asian Trade with Latin America: Impact and Evolution
Author: Martín Carlos PUCHET ANYUL
Co-Authors: Kaio Vital, marta reis castilho

Asia is a commerce partner with a growing importance for the countries of Latin America (LA). The commerce structure between the two regions has different characteristics and patterns respect to those that is observed among the Latin American economies. We analyse the trade relationships between the two major economies of LA (Brazil and Mexico) and Asia; we do a comparison of the trade flows between regions (Asia and LA) vis a vis the trade flows of each sub - zone of LA (MERCOSUR and NAFTA, respectively). The objective is to show comparatively the dynamics and the structure of commerce with Asia respect to that registered in the interior of LA. To this objective, we construct a total inter-country matrix and an inter – country input – output matrix, both matrices internally divided in sub-matrices that correspond to each commercial zones - MERCOSUR, NAFTA, SOUTH EAST ASIA and China. The data combine the international and intertemporal dimensions for the two regions and of the period 1995 – 2013.We use empirical information of the WIOD and EORA databases and we program algorithms to calculate the indicators and its paths and configurations. The different types of indicators are related to the

systemic integration, the vertical specialization and the structural circularity that reflect the absolute and relative importance of trade relationships of Asia – LA for the Mexican and Brazilian economies. In a specific manner, by using  a combination of the indicators, we discuss about the relative advantages of the commerce with Asia for the Latin American economies and we formulate an original interpretation of this phenomenon.

## Labor productivity, technological change and functional income distribution in Brazil and Mexico

Topic: 714D  Productivity and Efficiency (2)
Author: Martín Carlos PUCHET ANYUL
Co-Authors: Eduardo MORENO REYES, Kaio Vital, Manuel García Álvarez

The intermediate technology of the production sectors is subject to intense processes of economic trade opening and integration into global production chains. These processes have caused a major restructure of the relationships between domestic and imported inputs, Latin America is not the exception.

In sectors led by transnational companies that come from Southeast Asia and the US, the proportion of domestic supplies of specific inputs has decreased and imports have increased. In sectors where leadership belongs to companies inserted in global production chains from the great economies of Latin America - Brazil and Mexico - the change of internal inputs by imported inputs has been less relevant. However, in both types of sectors it is expected that intermediate technological changes are associated with increases in labor productivity. Concomitantly, they would observe an increased share of wages in value added.

On the other hand, the sectors whose companies recorded a smaller share in the global production chains, or are led by domestic firms, the internal inputs have maintained a higher proportion in the total. In these sectors, labor productivity has not increased much and the share of wages in income has been maintained or decreased.

The central purpose of this paper is to analyze the functional relationship between structural circularity, labor productivity and share of wages in value added in each industrial sector, for the cases of Brazil and Mexico, from a comparative and inter-temporal perspective. According to the development of Latin America, it is important to answer the next 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? ".

One way to capture the characteristics of intermediate technology sectors in the presence of significant changes in the composition of inputs is to observe the extent to which the path from supplier sectors to user sectors is amplified by feedback circuits both in the composition of domestic inputs as in the total inputs. The changes that take place when a sector moves from a sequential mode of supply - i.e. when is dominated by the sales that the sector does to another and this same to one more and so on until to arrive to an end-user sectors - towards a mode that is more circular in a specific manner in that some supplier sectors are in condition to buy inputs provided by sectors that are its own buyers. This change implies coordination and configuration of circuits of the sector with those of others. So a greater degree of intensity occurs in the use of the working capital and, at the same time, are introduced techniques that enable sectors located in the transformation of natural resources to go doing an increasing use of industrial goods and services to the production. The indexes of sectoral circularity are the indicators that permit to

measure this technological change.

The respective indicators are constructed and measured with the information of the tables of input - output for Brazil and Mexico in three key years - circa 1980, 2003 and 2013 – and considering compatible disaggregation levels because circularity rates are sensitive to the number of sectors. Data sources to be used are provided by the Statistic and Geography National Institute (INEGI) and the Statistic and Geography Brazilian Institute (IBGE) for the respective years.

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, even less, research has been conducted to consider this indicator of a joint form with labor productivity to determine the functional income distribution.

## Tracing and Quantifying Influences of Fossil Fuels in Thailand’s Economic Structure Using Multiplier and Structural Path Analysis

Topic: 514Y  Energy IO Modelling (1)
Author: Nattapong PUTTANAPONG

Objective
Thailand has pledged the Nationally Appropriate Mitigation Action (NAMA), which includes the sector-specific reduction of Greenhouse Gas (GHG) emission. For this scheme, the insight of economic structure, especially the roles of high GHG emitting sectors within the economy, is among important fundamentals. Hence, this study aims at examining how adjustments originated from high GHG emitting activities propagate throughout the economy.

Methodology
This study uses official input-output tables of 1990, 1995, 2000, 2005 and 2010  which are the most updated official data.  The computation of Leontief backward and forward multipliers is conducted to examine each production activity's propagation magnitude to other sectors.  In addition, Structural Path Analysis (SPA) is applied to further quantify the degree of economic linkages of high GHG emitting sectors along their supply chains.

Main findings
Interestingly, the multiplier analysis shows that the group of sectors having the highest values of backward and forward multipliers has been unchanged since 1990, and the refinery activity has been among these sectors having the highest forward multipliers.  This indicates the significant role of fossil-based energy in Thai economy since 1990.  The result from SPA also illustrates and quantifies that refinery is among the most influential sectors of origins, functioning as the starting point of many supply chains. These results indicate two important facts for developing the national GHG reduction plan.  Firstly, the fossil fuel has been the backbone of Thailand’s economic structure since 1990.  Therefore, the action to alter the fossil-based production network has to be very influential to reshape this persisting structure. Secondly, the refinery sector, considered as one of main GHG emitters, is the major upstream activity playing a very significant role in supplying most important paths of production chains. Hence, the adjustment of the refinery sector will inevitably propagate throughout all connecting supply chains and subsequently incur the high abatement cost of GHG reduction.

## Development of a quality adjusted labour productivity index in the European Union – Example of the employment embodied in European exports

Topic: 716Z Special session: International Trade Data Analysis in the Framework of Supply, Use and Input-Output Tables
Author: Isabelle REMOND-TIEDREZ
Co-Authors: Antonio F. AMORES, José M. RUEDA-CANTUCHE

The paper will introduce the methodology for the Quality Adjusted Labour Index (QALI) in the European Union which combines macro-data from National Accounts (which are the benchmarked data) and micro-data from the EU statistics of the Labour Force survey (LFS) and the Structural Earnings Survey (SES).
The Quality Adjusted Labour Input is constructed for the EU-28, EA-19 and each EU MS, whenever data are available, for the full time series from 2002 to 2013, with possible extension to 2014. Survey-based data of hours worked and earnings for 2002-2007 are converted from NACE Rev.1.1 to NACE Rev.2. The QALI values by EU Member State are weighted by skills, by age and by combinations of skill and age groups. The industry breakdown varies depending on countries due to reliability/confidentiality constraints of the survey data: 21 industries (A21) for some countries, EU28 and EA19; 10 industries (A10); and the total economy.
Connected to the decomposition of the volume by type of workers (by age and by skill), the results will give interesting insights on what kind of employment is supported by European exports in terms of age, qualifications, and in which industrial activities. The results will be based on the European consolidated Supply, Use and Input-Output Tables produced annually by Eurostat.

## New opportunities with EXIOlab – how virtual laboratories can help make IO-based research more timely and topical

Topic: 714W Special session: Input-Output Virtual Laboratories (1)
Author: Rachel C. REYES
Co-Authors: Tatyana Bulavskaya, Arne GESCHKE, Arjan de Koning, Hagen Schulte in den Baeumen, Konstantin STADLER, Arnold Tukker, Richard WOOD

A fearless forecast on the future of input-output analysis made three years ago envisions the launching of a Global MRIO Virtual Laboratory (VL) in 2016 (Dietzenbacher et al., 2013). It appears that what was then a mere dream has become closer to reality. In this work, we show that one of the major world input-output databases, EXIOBASE, can also be constructed well in a collaborative laboratory environment as EXIOlab. Taking advantage of common data sources for compilation but augmented with sources unique to the former's data processing, we describe the procedure for streamlining EXIOBASE's construction process that traditionally requires high degree of interrogation and adjustment to a single-step mathematical programming technique using high-performance computing afforded by the VL. The rigour involved though in realising the simplification of the compilation procedure is not trivial to ensure that the essence of the original EXIOBASE workflow is captured and respected in the construction of the initial estimate, constraints specifications and in making the appropriate concordances. The existence of EXIOlab presents new opportunities in IO-based research to be more timely and topical. With the flexibility possessed by the lab version comes possibilities such as simplifying the update of EXIOBASE, disaggregating regions for non-EU countries, introducing additional user-specific details, etc., that can make the result of the analysis done using the data more relevant especially for swaying

policy decisions.

## GVCs-Linked Spillovers and Development: Firm-Level Evidence

Topic: 711E Special session: SIC-OECD-IDE/JETRO Joint special sessions on Development, Employment and Inequality (1)
Author: Davide RIGO

Global Value Chain (GVC) integration has played an important role in industrial development for many developing nations. It is well established that imported intermediates boost productivity of developing-nation firms, both foreign affiliates and free-standing firms. But does this productivity boost spillover to the suppliers of these firms? This paper uses firm-level data (from the World Bank's Enterprise Surveys) to see whether developing country firms that participate in GVCs create positive spillovers for their upstream suppliers, and whether these spillovers depends upon foreign ownership. Turning to possible mechanisms, the paper shows that developing nation firms engaged in GVCs are more likely to use training programs, foreign-licensed technology, quality certification and the internet for communicating with customers and suppliers. In future drafts, the paper will seek to link the spillovers to these behaviors (please find attached an extended abstract of the paper).

## European Full International and Global Accounts for Research in Input-Output Analysis

Topic: 716Z Special session: International Trade Data Analysis in the Framework of Supply, Use and Input-Output Tables
Author: José M. RUEDA-CANTUCHE
Co-Authors: Isabelle REMOND-TIEDREZ

FIGARO (Full International and Global Accounts for Research in Input-Output Analysis) is a joint project between Eurostat and the European Commission’s Joint Research Centre aiming to establish an annual production of European Multi-country Input-Output Tables and a five-yearly production of European Multi-country Supply, Use and Input-Output Tables (EU-MC-SUIOTs). The EU-MC-SUIOTs constitute a further development of the current regularly published EU and Euro area consolidated SUIOTs. The EU-MC-SUIOTs will serve to support the analyses of the economic, social and environmental consequences of globalisation in the EU by means of studies on competitiveness, growth, productivity, employment and international trade (e.g. global value chains). The EU-MC-SUIOTs shall be complemented with:
a) A regular combination of micro and macro data sources to construct the EU-MC-SUIOTs (e.g. trade enterprise characteristics, multinational enterprises statistics, bilateral trade statistics, national accounts…);
b) Careful checking of user needs of various European Commission’s Directorate Generals for policy analyses;
c) An institutional perspective by setting up consistent EU-MC-SUIOTs, recognised by international agencies such as OECD, WTO and UN, and used as such in a Global Multi-country Supply, Use and Input-Output framework. National Statistical Institutes of the EU Member States would also participate in the discussions on the consistency between national trade data and international trade databases.
The EU-MC-IOTs will be constructed on the basis of the new SNA2008/ESA2010 methodology and the NACE Rev.2/CPA 2008/ISIC Rev. 4 classifications.

# The SUT-EURO and the SUT-RAS methods: extensions and fair comparisons

Topic: 516Z IO Accounts and Statistics (1)
Author: José M. RUEDA-CANTUCHE
Co-Authors: Juan Manuel Valderas Jaramillo, Elena Olmedo Fernández, Joerg Beutel

The EURO Method for SUT tables (Beutel, 2008) along with the SUT-RAS Method (Temurshoev and Timmer, 2011) are among the most popular and recent contributions for projecting Supply and Use tables, having these methods been used in an extensive way for these purposes (v.gr. Eurostat, WIOD project...). The empirical assessment of these methods casts a better performance of the SUT-RAS method compared to the EURO method, which may lead to favour the use of the first one for practical applications. However, this comparativeness is uneven since the SUT-RAS method requires larger exogenous information (outputs by industry) than the EURO method. This larger information, when available, may constitute an advantage for the SUT-RAS leading to the better performance. At the same time, when this information is not available the application of SUT-RAS is not possible. Could these methods be compared in a fair way? If this is possible, what methodology is better when confronting a practical application of these methods according to the available exogenous information for the projection period?

The authors have extended both methods in a double direction, extending the EURO Method to incorporate the output by industry among the exogenous information available for the projection, and restricting the SUT-RAS Method to exclude the output by industry of the available exogenous information. At the same time, these methods have been adapted for an explicit treatment of Taxes less Subsidies when this information is available in the projection period. In this way, it is possible to test the performance of these methods in a double scenario. First, a scenario with more restricted information, that is similar in terms of the available exogenous information to the one that traditional EURO Method demands. And a second scenario, with more extended available information for the projection, that is similar to the one where original SUT-RAS works.

Exogenous Information Available required

For Scenario 1: SUT-RAS1 and SUT-EURO1

- GVA by industry
- Final Demand totals
- Total of imports
- Total of Taxes less Subsidies

For Scenario 2: Scenario 1 + Output by industry -> SUT-RAS2 and SUT-EURO2

We apply these methods to a series of benchmark SUTs for the period 2000-2005 of Austria, Belgium, Italy and Spain with a disaggregation of 60 products, 60 industries and 3 components for the Final Demand. Benchmark use tables at basic prices were available only for these countries. We compare the results of the SUT-EURO method against the SUT-RAS in both scenarios, and also compare the outcomes methods in scenario 1 against their correlatives in scenario 2.

Methods developed in this work are completely original extensions of the EURO Method for SUT of Beutel and the SUT-RAS of Temurshoev and Timmer. We have extended the SUT-EURO taking the output by industry as exogenous without losing the essential characteristics of the original EURO

Method, making possible to test the EURO method evenly with the original SUT-RAS. Also an explicit treatment of taxes less subsidies is done in our methods, which is also an original extension for both methods. Concerning the SUT-RAS-1 we have achieved to restrict the SUT-RAS, taking the output by industry as not available and, hence, it has to be projected endogenously. We have achieved this goal without losing the bi-proportional feature of the SUT-RAS method working, as in the original, in the context of an integrated supply and use framework. Outcomes achieved in our work allow us to assess what method is more suitable depending on the exogenous information available at the moment of the projection. Our outcomes have been tested for 4 countries, as stated above, and using different goodness of fit statistics, including some goodness of fit statistics that are also new in the context of matrices projections.

References:
- Beutel, J. (2008) “An Input-Output System of Economic Accounts for the EU Member States”. Interim Report for Service Contract Number 150830-2007 FISC-D to European Commission. Directorate-General Joint Research Centre. Institute for Prospective Technological Studies.
- Temurshoev, U. y Timmer, M.P. (2011) “Joint estimation of supply and use tables”, Papers in Regional Science, vol. 90, iss. 4, pp. 863–882.

## The Heckscher-Ohlin theorem and the open Mexican economy: a structural analysis

Topic: 809Z  International Trade (1)
Author: Pablo RUIZ NAPOLES

According to the Heckscher-Ohlin (H-O) Theorem, free market in international trade is said to optimize production and consumption of a country by partially specializing its economy in the areas of production where it has comparative advantages derived from its relative factor endowment and obtaining in exchange those goods it produces with comparative disadvantages.
The H-O Theorem has been tested by various methodologies in different countries’ cases. Still, the most cited has been the one conducted by Wassily Leontief for the U.S. economy using its 1947 Input-Output table. However, his results contradicted the Theorem predictions, which gave rise to the so called “Leontief Paradox”.

Using an Input-Output model, in this paper we test the Heckscher-Ohlin Theorem in the case of Mexico for the period in which free international trade has prevailed, to find out whether the Export-led strategy with free trade, followed since 1983, has succeeded in revealing Mexico’s comparative advantages, based on its relative factor endowments as the Theorem dictates. For this research we used a 700 entries Input-Output Tables of the Mexican Economy of 2003 and 2008 recently published and the capital and labor vectors of the same size for the same years, provided by the National Institute for Statistics and Geography (INEGI) in Mexico. Noboby has had these data before in Mexico for any particular year, so this is something very original.

## Assessing the economic impacts of nuclear energy in Malaysia

Topic: 516Y  Energy IO Modelling (2)
Author: M. Yusof SAARI

Under the Economic Transformation Programs (ETP), the Malaysian government is planned to run a twin-unit of nuclear power plants with a total capacity of 2x1000 megawatt-electric by 2021. It was well documented in the literature that nuclear power plant has demonstrated its capacity to produce base-load electricity at a low, predictable and stable cost due to its low dependence on the uranium price. However, empirical evidences on the economy-wide impacts of nuclear power plants are lacking. Based on this premise, this paper aims to measure the extent to which running the twin-unit of nuclear power plants affects the Malaysian economy. To achieve the objective, we extend the econometric-input-output prototype model that developed by the International Atomic Energy Agency (IAEA) by integrating the analysis of income inequality. To run the model, we construct time-series input-output tables for Malaysia from 2000 to 2014 and based on the series a projection for the 2020 input-output table is made. This paper not only shows a significance contribution to the literature on economic-nuclear energy assessment, but also provides valuable information in formulating appropriate energy policy in Malaysia.

## Sectoral Linkages and Labour Productivity: Panel Data Analysis for Turkey

Topic: 811X  IO Analysis for Policy-making (2)
Author: Aykut SARKGUNESİ
Co-Authors: Necla AYAS

Theoretically, linkages between agglomeration and productivity; studied within the scope of economical geography, Industrial Organization Approach and Endogenous Growth model. According to Economic Geography Approach; impacts of agglomeration on productivity is explained by the effects of both labor and intermediate input market arising from specialization (Krugman, 1991, Fujita and Thisse, 2003). With regard to Industrial Organization Approach; sectoral and inter sectoral linkages have been taken into account as a main source of productivity and it asserts that agglomeration influes productivity positively both in firm and sectoral level. (Tirole, 1988). With respect to Endogenous Growth Theories; relation between agglomeration and productivity is clarified with knowledge diffusion and technology externalities. Since increasing importance has been given to social relations between economic agents in modern economies, validity of Industrial Organization Approach has been analyzed for Turkish Economy on the basis of sectors between 1995 and 2011.
The productivity accepted indicator of performance is measured as both partial productivity of each inputs and total factor productivity exhibiting ratio of outputs to inputs (Andersson and Lööf, 2009). While labor productivity has been chosen as dependent variable in the study, backward and forward linkage coefficients were added to model as independent variable. Also ratio of export to output and capital-labor ratio included so that improve ability of the model to measure impacts of agglomeration effects on productivity.
To achieve aim of the study; values of the both dependent and independent variables were calculated from Turkey National Input Output Tables for both 1995 and 2009 years which have been published by World Input Output Database (WIOD). 35 sectors in the National Input Output Tables aggregated to 25 sector groups with regard to input output methodology and coefficients calculated on this aggregation. Panel data analysis has been used to detect relations between industrial/inter industrial linkages and productivity and if agglomeration have significant impacts

on labor productivity. Possible cross-section dependency and heterogeneity problems are taken into account in the model and the best estimation methods were preferred in the study.
As we researched it is not found any study in this field using these methods and findings of our study are expected to understand determinants of labor productivity that is one of the major source of economic growth.
Keywords: Heterogeneous Panel Data, Sectoral Linkages, Labor Productivity

## Estimating the Technological Factor’s Contribution in Economic Dynamics

Topic: 814X  Structural Change and Dynamics
Author: Alsu SAYAPOVA
Co-Authors: SHIROV Alexander, Nikita Vasilyevich NEZHELSKIY

The present paper is a continuation of research on the analysis of spatio-temporal characteristics of the technological coefficients, the results of which were presented at the previous Input-Output conference.  This stage in research is characterized, firstly, by the broadening of the database of national economic systems included in the comparative analysis with Russian technological coefficients.  Secondly, based on total requirements coefficients, the component determined by changes in technological coefficients in the economic dynamics is singled out as object of research, and the position of Russia on this indicator is estimated using cross-country comparisons. Thirdly, the evaluation of the technological component in the economic dynamics is performed based on global and national input-output tables, including the estimated contribution of technological changes in the world economy. Fourthly, in line with the expansion of the cross-country research base, there is also an extension of the list of industries, the cost structure in which is subjected to scrutiny.  This research must result in forecast and analytical calculations with various scenario options of technological coefficients for Russia.
Unfortunately, despite the relevance of this line of research, Russia does not have a sufficiently complete own information database for the analysis of the dynamics of technological coefficients, not to mention the limited possibility of cross-country comparisons using such database.  For this reason, in addition to the official data of the state statistical agencies of Russia, we have to go to international databases for these purposes, in particular to WIOD.

Key words: technological coefficients, total requirements coefficients, economic dynamics.

* The work was supported by Russian Fundation for Humanities (project 16-32-00063).

## Assessing the drivers of CO2 emissions: An hybrid MRIO-panel data analysis

Topic: 714F  Environmental IO Modelling (3)
Author: Ana SERRANO
Co-Authors: Rosa DUARTE

The concerns on the actual effects and potential consequences of climate change have notably increased in the last decades. There exists nowadays consensus in the literature regarding the direct link between greenhouse emissions and rising temperatures at the global level (Stern, 2006; IPCC, 2014).  Despite large advances on the understanding of this phenomenon, further research on the economic determinants of gas emissions is necessary to shed light on the

transmission mechanisms into the environment.
In this context, this paper aims to study the trajectories and explaining factors of C02 emissions in the world during fifteen years. Our methodology relies on a multiregional input-output model (MRIO) environmentally extended to estimate CO2 emissions both from the consumer and producer approaches. Drawing on data from the World Input-Output Database (WIOD), we estimate embodied emissions in production and consumption activities in 40 countries from 1995 to 2009. This empirical approach allows us to examine regional and sectorial features from a long term perspective. Secondly, we will assess the determinants of CO2 emissions combining IO (Input-Output) modelling alongside with panel data analysis. A correct specification of the model requires data from external sources (e.g. World Bank World Development Indicators, FAOSTAT, etc.). In addition, the MRIO tables provide rich information to build indicators controlling for some of the CO2 emissions drivers. Therefore, our analysis will include explanatory factors such as economic and demographic growth, technological change, the growing integration of economies, sectorial specialization, variation in consumption patterns, structural change, efficiency improvements, the quality of institutions and the ratification of the Kyoto protocol, among others.

This paper will contribute to the environmental literature offering a new and robust methodological approach that explains and quantifies the factors lying behind pollution. The combination of IO analysis and panel data econometrics will suppose a step forward on the assessment of the impact of economic growth, and the processes associated with it mentioned above, on CO2 emissions.

## Inequalities and household carbon footprint: the allocation of emissions embodied in investment

Topic: 711F Inequality and Environment
Author: Mònica SERRANO
Co-Authors: Narasimha Desirazu Rao, Jordi Roca

The consequences of rising greenhouse gases emissions, increasing (income) inequalities and the relationship between the two have attracted a growing interest in recent years. In this global context, it is important to develop climate policies that do not cause rise in economic inequalities and, at the same time, to promote inequality reduction policies that reduce carbon emissions. However, an international environmental database that would allow comparable estimates of household carbon footprints at different income level and for different countries is still missing. As a result, research on inequality and emissions remain either too theoretical or too narrow-focused.

Any international environmental database aimed at orienting empirically the debate on to whether a more equitable society could be also a less carbon-intensive one needs to be grounded in a robust and systematic method that enables cross-country comparison of household carbon footprints. Filling this data gap requires, among other things, solving some outstanding methodological issues such as how should be considered emissions of non-monetary activities, government expenditure, under-reported top income expenditures, or capital investments. The latter is particularly important for emerging economies, where capital investment is a relatively high share of carbon footprint of final demand.

This paper explores one of these methodological issues, the emissions embodied in investment. In particular we focused on the estimation of carbon emissions of gross fixed capital formation of industries and how these emissions should be allocated to final consumption expenditures of

different income-level households. This issue has been recurrently omitted in household carbon footprints. There are two very different aspects. On the one hand, carbon footprints of households classified by income- level implicitly assume that emissions related to household savings are zero; however, through the financial sector part of those savings are typically borrowed by industries to buy capital goods, such as equipment, machinery, or buildings whose production involves emission of different gases. And on the other hand, standard input-output models account for the consumption of circulating capital, i.e. the consumption of intermediate goods, but not for the consumption of fixed capital, i.e. depreciation of capital goods, which is required for linking emissions embodied in investment of capital goods and the consumption of that capital goods in the production processes of industries. This paper will offer a theoretical discussion of how these aspects can be addressed in input-output models, and provide empirical evidence using the case of Spain. We choose a European country because of our expertise and access to data.

## Unconventional monetary policy expansion: the economic impact through a dynamic CGE model

Topic: 514C  CGE/econometric IO Modelling (1)
Author: Francesca SEVERINI
Co-Authors: Clio CIASCHINI, Rosita PRETAROLI, Claudio SOCCI

The ongoing economic stagnation and low inflation rates affecting EU have refuelled the debate on the role and the limits of monetary policy in pushing the economic growth. Given the tight margins for fiscal policy for EU state members, traditional and unconventional monetary policies are becoming more looked-for to break out of this condition. However, the main issue on whether the real or nominal aspects prevail still remains. In this situation, a framework able to identify and analyse any interaction between economic and financial flows becomes crucial to detect the dynamics pushing towards expansions or contractions resulting from monetary policies. Therefore, the aim of this paper is to investigate the direct and indirect impact of monetary policies implemented by the European Central Bank on the main Italian macroeconomic variables both in aggregate and disaggregate terms. For this purpose we use Dynamic Computable General Equilibrium model calibrated on the Social Accounting Matrix integrated with financial tools.

Keywords: Financial account, Monetary policy, Social Accounting Matrix, dynamic CGE model.
JEL classification: C63, E17, E52, D57, D58.

## Shadow Prices of Energy in Economic Sectors of Iran

Topic: 516Y  Energy IO Modelling (2)
Author: Nooraddin SHARIFY

Shadow price of production sources is employed for price policy analysis. These indicators let the researchers/ policy makers to examine, specially in the regulated price production sources, their policy. Using an input-output analysis, this paper develops an approach to examine the shadow price of energy of economic sectors of Iran. The input-output table of Iran for the year 2012 is employed as database of the research. The model is capable to be used for other production sources such as water.
Keywords: Shadow Price, Input-Output, energy, Iran.

# The trade-offs between carbon and critical metal footprints of Japanese households

Topic: 514F  Environmental IO Modelling (1)
Author: Yosuke SHIGETOMI
Co-Authors: Keisuke NANSAI, Susumu Tohno

In recent years, the importance of measuring various environmental footprints of a product and those of a nation has been growing to realize multiple environmental managements toward sustainable consumption and production. The 17 Sustainable Development Goals (SDGs) put forward by the United Nations, for instance, need to consider multiple criteria and their synergies and trade-offs. From this point of view, it is essential to scope the trade-offs between greenhouse gas (GHG) emissions reduction and mineral resources consumption, such as “critical metals” necessary for low-carbon technologies (i.e., fuel cells, electric vehicles).
For carbon footprint of a nation, some studies have demonstrated that household consumption is the greatest contributor among final demand categories. No study has examined, however, the similarities and differences between carbon footprint and material footprint associated with household consumption, despite anxiety related to increased demand for metals with the expansion of new energy technologies.

Against this background, this study simultaneously addresses the carbon and material footprints for the three critical metals (neodymium, cobalt, and platinum) in Japanese households with different income levels. In addition, the policy implications of the trade-offs between GHG mitigation and critical metals consumption are considered within the context of these differences in income.

This study employed a global link input-output model (GLIO) to analyze the household carbon footprint and material footprints for the critical metals. The GLIO is a simplified MRIO that centralized on Interindustry of Japan with global supply chains expressing the sectors of 230 countries and regions. The demand of the target metals here will be expected to increase with the further expansion of new energy technologies. We regarded five household types with different income levels (income quintiles) and estimated respective annual expenditures by disaggregating the household sector defined as a single sector in Japan input-output table (JIOT) into the five household sectors with the national household statistic. Then, they were calibrated with mathematical programming to be consisted with the annual expenditure of each commodity written in JIOT. In addition, the expenditure of each quintile was equivalized by the OECD square root scale with respect to household size, in order to improve an accuracy of comparison in the footprints among households.

As a result, the range of carbon footprints among income quintiles was quantified to be 12-17 t-CO2eq/y, while that of equivalized expenditures among quintiles was 2.53-4.65 million-JPY/y. In other words, the difference of carbon footprints between the minimum quintile and the maximum quintile is about 1.4 times, while that of consumption expenditures between them is about 1.8 times. Thus, the carbon footprint intensity of household (carbon footprints per unit household expenditure) gradually declines as household income increases. In addition, the ranges of material footprints for neodymium, cobalt, and platinum were observed to be 2.2-7.1 g/y, 32-67 g/y, and 0.073-0.16 g/y, respectively. In contrast to the carbon footprint intensity, however, these material footprint intensities rise as income increases. The difference of trends between both footprint intensities implies that the implementation of subsidies aimed reducing carbon footprints and stimulating the economy should carefully consider the unexpected increase in material footprints.

More detail results and discussions will be presented at the conference.

## A Cross-country Analysis of Material and Energy Implications of Structural Change

Topic: 814X  Structural Change and Dynamics
Author: Kayoko SHIRONITTA
Co-Authors: Shigemi Kagawa, Keisuke NANSAI, Sangwon SUH

In this study, we analyze the effects of changes in material and energy input structure on the CO2 emissions embodied in consumption. Previous studies demonstrated the connection between domestic structural change–such as the shift toward a service economy—and the increase in greenhouse gas (GHG) emissions embodied in consumptions of a specific country (United States or Japan) (Suh, 2006; Nansai et al., 2009). This study is an follow-up research that examines the effects across countries and evaluates whether or not the development levels of countries explain the structural effects on CO2 embodied in consumption. Specifically, we employed a multiplicative structural decomposition analysis based on the World Input-Output Database (WIOD) during 1995 to 2009 (Dietzenbacher et al., 2013) and decomposed life-cycle CO2 emissions of 40 nations into the following four inducement sources: (i) inputs from material goods (including energy) to material goods, (ii) inputs from material goods to services, (iii) inputs from services to material goods, and (iv) inputs from services to services. The results show that in Japan the CO2 emissions embodied in consumption that are associated with the inputs from energy and material goods to services increased during the study period (1995-2009), whereas countries like U.S. and U.K. show the opposite effects. Thus, the effects of structural change on CO2 embodied in consumption vary across countries, and the panel data analysis using the results did not show any statistically significant relationship between the structural effect and the development levels. Finally, this study highlights the increasing importance of energy and materials consumption by services in the context of climate change policy.

## Projecting Malaysia Input-Output Table Using Euro Method

Topic: 516Z  IO Accounts and Statistics (1)
Author: Norhayati SHUJA'
Co-Authors: Bee Wah Yap

Input-Output (I-O) tables provide a detailed account of the flow of production and consumption of goods and services from producers to consumers. It serves as a dataset for I-O analysis which provide the tools to perform economic modeling. The construction of the I-O tables based on detailed census or surveys is a complex procedure that requires substantial financial expenditures, large human capital and time. The work involved to prepare an input-output table is enormous and therefore, has led to the emergence of non-survey updating techniques. Hence, the availability of updated input-output table has become a major concern in the analysis of the country’s economy for an effective assessment of the contribution of industries to the economy. In view of its significant importance in providing up to date inputs for applications in a wide range of economic analysis and decision making activities, therefore, the aim of this study is to project the Malaysia Input-Output Table (MIOT) for the year 2014 using Euro Method which was proposed by Beutel (2002). The basic idea of using the Euro method is to generate estimates of the I-O tables which are consistent with official macroeconomic data. The actual MIOT 2010 was used as

the base year for the iteration procedure to construct a projected MIOT 2014. The sectors in the MIOT 2010 were aggregated from 124 sectors to 12 main sectors (industries). The projection of MIOT involved an intensive iterative procedure using MS-Excel Visual Basic programming. The initial values for value added by sectors, total final demand by use category and total value added for the iteration process were obtained from Malaysia Gross Domestic Product for 2014. Next, using the projected MIOT 2014, we analyzed the inter-industrial linkages of the industries sector in Malaysia based on the forward and backward linkages using Hypothetical Extraction Method (HEM). The HEM was proposed by Strassert (1968) and further formalised by Dietzenbacher et al. (1993) and Dietzenbacher & van der Linden (1997). HEM was applied to quantify explicitly the importance sector to the economy. The findings of the HEM show that the manufacturing sector has a strong degree of the backward and forward linkages. The results suggest that the manufacturing sector is an important sector to the Malaysian economy.

i) Research Question: (a) The Malaysia I-O tables are published on average five years after reference year. The long time lag creates the opportunities for the reported data to change over time, such as, technological change. Therefore, what is the alternative solution to construct an updated Malaysia I-O table.
(b) How to identify the important sector for the development of the Malaysian economy.
ii) The method used: (a) The Euro Method for projecting I-O table and (b) Hypothetical Extraction Method to measure the linkages of the industries sector to the Malaysian economy.
iii) The data used: Malaysia I-O table 2010 and Malaysia Gross Domestic Product for year 2014.
iv) The novelty of the research: In view of the difficulty of obtaining up-to-date Malaysia's Input-Output Tables, therefore, there is a need to find a solution to the problem pertaining to the large time lag required to obtain the data for economic planning purposes. One such alternative is to project Malaysia I-O table with the hope that the projected data reflect the current economic environment. Currently, besides existing benchmark Malaysia's I-O table, there is no projected or updated I-O table produced in Malaysia. The projection of the I-O table involved an iterative process using Microsoft Excel Visual Basic Programming. This programme has been developed for the projection and can be very useful for the practical applications at Statistical Offices all over the world.

## Economy wide impact of TPP: New Challenges to China

Topic: 514X Special session: Economic Implications of Transpacific Partnership Agreement (TPP)
Author: Chandrima SIKDAR
Co-Authors: Kakali MUKHOPADHYAY

October 4, 2015, saw the announcement of the conclusion of the negotiations on Trans-Pacific Partnership (TPP) Agreement by the Ministers of the twelve TPP countries – Australia, Brunei Darussalam, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, United States, and Vietnam. The objective of this ambitious and comprehensive agreement is to promote economic growth; support the creation and retention of jobs; enhance innovation, productivity and competitiveness; raise living standards; reduce poverty in the member countries; and to promote transparency, good governance, and enhanced labour and environmental protections. The conclusion of this agreement is envisioned as an important step towards the members' ultimate goal of open trade and regional integration across the region.
The TPP is no doubt the largest regional trade accord in history, and if approved, it will set new terms for the nearly $28 trillion in trade and business investment between the parties to the deal, but the point to note is that it does not include China, world's largest merchandise trader, which had a combined exports and imports worth of US $ 4,303 billion in 2014 (WTO). So the obvious

question that arises is- What does TPP mean for China?
Until about three years ago, China routinely denounced the TPP, holding that it was one of the many efforts to contain China. However, China has in recent years dropped this blanket opposition, and taken a more nuanced “wait and see” attitude. Thus, currently, China is not ready to meet the demanding requirements of the TPP agreement but possibly might join the group in a few years from now.
Against this backdrop, the present paper seeks to analyse the impact of this TPP agreement on the various trade and other economic variables- income, employment, wages, welfare etc of China. The study resorts to an applied general equilibrium (AGE) analysis for this purpose. It uses the Global Trade Analysis Project (GTAP) and does a number of simulations through GTAP data by calibrating various trade integration scenarios between the twelve TTP countries and studies the impact of the agreement on China. The simulations broadly include the following scenario where:

- Existing tariffs on goods between member countries are reduced first to 50 per cent and then eliminated completely.

- Scenario where the goods traded extensively as inputs between the members are allowed added tariff reduction and the sectors using these inputs experience input augmenting technical change. This simulation aims to capture the impact of developing production and supply chain within the TPP region.

- Reduction of trade costs such as customs fees, port handling charges, and informal payments and the cost of time in trade between the member countries. These costs are incorporated in the CGE modelling framework of GTAP as tariff equivalents.

The preliminary results indicate that China’s trade with the World, particularly exports will suffer post the implementation of the TPP agreement. Some of the sectors which are likely to be hit majorly are leather, motor vehicles, processed food, iron and steel etc. The TPP would also result in welfare loss to China on account of all of loss of allocative efficiency, endowment and deterioration of terms of trade. Of these, worsening of terms of trade explains the largest part of welfare loss for the country.

## The Linkages between Real and Financial Sectors in the Indian Economy- A Financial Social Accounting Matrix Approach

Topic: 711C  Social Accounting Matrix
Author: Chandrima SIKDAR

In today’s globalized world, the real and financial markets within an economy and across economies of the World are very strongly integrated. Understanding the nature of this integration and quantifying it with respect to an economy is very important to comprehend the transmission of any kind of shock – real or financial to the various sectors of the economy. This understanding also helps significantly in effective policy making. Against this backdrop, the present paper seeks to develop a financial social accounting matrix (FSAM) for India- one of the fastest growing emerging economies of the World. Based on a social accounting matrix for India 2007-2008, the present paper develops the financial social accounting matrix for the economy by incorporating income and financial flows into it. Then using this FSAM, the study presents an expanded multiplier analysis such that it incorporates three types of interlinkages – direct, indirect and induced for both backward and forward linkages as also valued added multipliers. The theoretical

framework developed in the paper helps to calculate multipliers that provide quantitative assessment of the overall as well sectoral impact of any changes in the economy, be it in institutions or in industrial structural or in economic behaviour.
The novelty of the paper lies in the fact that it provides an alternative way of identifying the vulnerabilities and strengths between and across sectors in an economy. Second, it does it for India, an exercise which so far has not been attempted by any researcher to the best of the knowledge of the present researcher.
The initial findings indicate that sectors like trade, communication, transport, services have strong linkages with other sectors of the economy. While, sectors like agriculture and manufacturing share relatively weaker linkages with the other sectors of the Indian economy.

## Conceptualizing Gender CGEs with Intra-Household Bargaining

Topic: 809D  Special session: Modeling Impacts of Structural Change in Emerging Economies (1)
Author: Anushree SINHA

With greater economic opportunities appearing in emerging economies for work participation, it becomes important to examine how women would react to such opportunities in the economy. The lack of reliable data for carrying out economy wide exercises has restricted such analysis. Hence, generally more research in relation to gender analysis has focussed on their microeconomic aspects using case study data. A lack of an overall macro perspective of the interrelationship of women worker, and the situation which determine women's performance and welfare with other economic agents could lead to macro programs that could have high risks in achieving developmental goals of a nation. In the most recent discourse on macro perspective on gender and work, the inclusion of work marketed, termed as non-market work, is accepted to be essential to be factored in macro-economic analysis for human capital development. The Beijing Platform for Action (PFA 1995), incorporated gender concerns and mandated that governments to "review and modify, with the full participation of women macro-economic objectives and social policies with a view to achieving the objectives of the Platform for Action." It is important to note that the PFA advocated the need to develop statistical data and methods to capture all kind of participation made by women in the economy. Hence, we need to recognize that methods of both surveys and other quantitative tools are necessary to fully take into account all types of work, including non-market work undertaken by women.
In this paper we would conceptually discuss the ways in which a CGE model needs to be engendered by taking into account the above deliberations including data reconciliations for constructing an engendered Social Accounting Matrix (SAM). We will draw to some extent from literature on intra-household bargaining and mostly from the rare gender CGE model analyses. We would start from a Computable General Equilibrium model developed by Sinha, et al (2003), where the SAM is developed with sectors that have important shares of women workers in different sectors of the economy. In this SAM, the workers are distinguished as casual, regular, own account workers, employers and home-based workers. The SAM developed with such distinctions is used as the base for building a CGE Model. Further Sinha (2009) describes a Gender aware CGE model on the basis of a gender aware SAM that also distinguishes non-market work in addition to market work.

Also, recognizing the importance of the role of household resource allocation has to be distinguished by gender, Siddiqui (2005) notes that it is important to determine from survey data how resources are actually allocated within a household. Using her method for the Indian CGE we could use household data and identify some aspects of the rules whereby resources are allocated to different groups of people within a household. Using household consumption data a number of

hypotheses needs to be tested to predict intra household allocation of resources. The analysis could be parametric to start with the specification of a standard model linking expenditure to income and demographic characteristics of individuals. We would build share of consumption of a man and a woman in total consumption of goods of a household with one adult man and one adult woman. Using these ratios and taking into account the number of adult equivalent males and adult equivalent females in a household, household's resources could be divided between men and women in a household. To determine the bargaining power, female education (mother's education) or share of female unearned income in total households' income could be deliberated upon and then used. Though household consumption is determined by prices and income, the distribution of the consumption across male and female members in a household is determined by the indicators of empowerment and discrimination at the household level. Taking this route one could develop a gendered social accounting matrix to be the dataset for a CGE (using the NSSO, CSO and NCAER data). Such a CGE could be made gender aware by developing interaction between paid (monetized) and unpaid (non-monetized) sectors of the economy, introducing, paid and unpaid work and intra household allocation of resources. Also it is necessary to assume that female consumption is different from male consumption within a household. Further stylization is that all females have one type of preference and all males have similar preferences. Such a model could determine whether during a slump, women's consumption is more adversely affected than men's, etc. Does higher women's bargaining power help to improve their condition? We would examine whether inclusion of intra-household allocation of resources could provide a nuanced gender CGE analysis. We would then develop such a CGE model for India.

## Environmental impacts of capital formation

Topic: 514F  Environmental IO Modelling (1)
Author: Carl-Johan H. SÖDERSTEN
Co-Authors: Edgar G. Hertwich, Richard WOOD

The impacts of infrastructure development are a well-known driver of economic activity, associated resource use and environmental impact. In National Accounting, gross fixed capital formation (GFCF) constitutes a substantial share of the total final demand of goods and services, both in terms of monetary turnover and embodied resources. Further, a large share of today's developing countries are expected to build up their infrastructure in the coming decades, and climate change mitigation scenarios entail significant investment strategies starting before 2020. A deeper understanding of capital investments could therefore provide a valuable insight for further energy and climate research. Despite this, there has been relatively little focus on capital in the environmental scientific literature.
In this article, we study the structure of GFCF and the environmental impacts associated with it on a global scale and link it to measures of development, using input-output analysis and the EXIOBASE EU KLEMS databases. We find that the share of GFCF as part of the total carbon footprint varies a lot more across countries than GFCF as a share of gross domestic product, and that countries in early phases of development generally tend to invest in dirtier assets than developed countries. By performing a structural decomposition analysis, we assess the relative importance of investment structure and input-output multipliers for the difference in carbon intensity of capital assets, and find that the structure of investments plays a larger role for developing countries than for developed countries.

## The economic impact of the preservation and adaptive reuse of rail tracks, the high line in New York City: regional impact analysis and property value change analysis

Topic: 809X IO Analysis for Policy-making (1)
Author: Jiyoon SONG

Considered to be one of the most successful recent economic development projects in New York City, the transformation of a recent section of former New York Central Railroad elevated track to the now-famous High Line Park has been the envy of designers and preservationists in cities across the US.

The High Line project has been looked to as a model for a large number of cities with significant tracts of disused industrial infrastructure from the heyday of American railroads. Philadelphia is just one example of a community that has been attempting to replicate the High Line's success. However, the significant capital investment required to adaptively reuse elevated railroad structures is challenging.

A critical examination of the High Line's economic impact, this study attempts to balance the sticker shock of such capital investment with the ongoing development benefit. It considers the number of jobs created by the project, the increase in household income and property values within the neighborhoods adjacent to the line, and subsequent demands on other industries.

The study employs two quantitative methods to arrive at its conclusions: (1) Input-output analysis for measuring the exact the dollar amount of economic benefits from historic preservation; (2) Geographic Information System (GIS) to present the changes of property values by collecting the data of property values along the High Line. This thesis concludes that there has been a positive economic impact from the High Line Park development.

## EXIOBASE 3 - Compilation and analysis of an EE MRIO time-series in current and constant prices

Topic: 514Z Special session: Compilation and Application of EXIOBASE 3 – a time series of highly detailed EE MRIOs
Author: Konstantin STADLER
Co-Authors: Richard WOOD, Tatyana Bulavskaya, Carl-Johan H. SÖDERSTEN, Arjan de Koning, Arnold Tukker

Effective policies to facilitate sustainable development require a globally consistent accounting framework to assess the social and environmental impacts of our activities. Environmentally Extended Multi Regional Input Output tables (EE MRIOs) gradually emerged as the main framework to provide such a comprehensive description of the global economy and its effects on the environment. In the last years, EE MRIOs have been continuously refined to provide a complete and coherent description of our society.

Of the available EE MRIOs, EXIOBASE stands out in providing a SEEA compatible accounting scheme with a high sectorial detail matched with multiple social and environmental satellite accounts. However, the currently available EXIBOASE versions only give snapshots of the global economy. This impedes any analysis of sustainable development as for example decoupling over time.

This issue was addressed within the DESIRE (Development of a System of Indicators for a Resource efficient Europe) project. Here we present the work leading to the latest iteration of EXIOBASE: EXIOBASE 3 - a time-series of EE MRIOs in current and constant prices.

EXIOBASE 3 builds upon the previous versions of EXIOBASE: The main building blocks are rectangular Supply-Use Tables (SUTs) in a 163 industry by 200 products classification. In order to capture structural changes, we based the time-series on these available EXIOBASE 2 tables from 2007 and imposed the reported changes of the economy based on data from national statistical agencies. These initial estimates were further refined by incorporating detailed data on energy accounts (from IEA), agriculture production (FAOSTAT) and bilateral trade (BACI database). Balancing followed a three layered top-down approach: First, we setup a balanced macro-economic database based on the UN SNA main aggregate database with additional data on the Taiwanese economy. In the second step, a balanced, bilateral trade cube was constructed by combining various data sources (BACI/UN comtrade, IEA, UN service trade). Finally, the trade cube was collapsed into total import and export per country and incorporated into the initial SUT tables. These were than balanced respecting the macroeconomic and trade constraints.

EXIOBASE 3 is available in current and constant price data. The conversion was done by applying deflator values based on national account data, physical production data, price data and other auxiliary databases. EXIOBASE 3 inherits the high level of sector and environmental stressor detail from its precursor. The satellite accounts for resource extraction were further improved and now incorporate the full detail of resource extraction for agriculture commodities from the FAO data. To account for the expansion of the EU, EXIOBASE 3 was developed with the full EU28 country set (including the new EU member-state Croatia).

EXIOBASE 3 is a unique tool for analysing the dynamics of environmental impacts over human activity over time. We will highlight some top level results from a first analysis of EXIOBASE 3 and conclude by showing some potential applications of the new EE MRIO time series.

## Open, closed and semi-closed IO models; Theory and Application

Topic: 516B  Special session: The Use of Open, Semi-Closed and Closed IO Models; Theory and Application
Author: Albert E. STEENGE

In this paper we take a second look at the relation between what commonly are known as open, semi-closed, and closed input-output (IO) models, respectively. All three types of models have provided answers to particular sets of questions, often related to labour market or income distribution situations.

Treating open and closed models as polar cases, in this contribution we shall focus on the semi-closed and closed models. We briefly review the established pedigrees, thereby focusing on the contributions in the 1970s and ‘80s and providing special attention to the position of Miyazawa-related modeling.

We signal, however, that important questions in the relation between  prices and price formation on the one hand and income distribution formation on the other are not well-understood in the present setting. This is particularly important in relatively new areas of socio-economic policy analysis, including catastrophe or climate change analysis. In this contribution we propose an

alternative classification for IO modeling, focusing on what we – for the moment – have called the "internal" structure of the models in question. We provide some examples and discuss a possible future agenda.

## Non-Tariff Measures Trickling through Global Value Chains

Topic: 516W Special session: Global Production Networks: Theory and Empirics (2)
Author: Robert STEHRER

In the current globalization process geographical and local production processes are intertwined through global value chains (GVC). In the presence of GVCs import tariffs do not only affect the direct trading partners but have indirect impact through international linkages. This is also the case for non-tariff measures (NTMs) which have gained importance in the last decades. In the presence of increasing use of non-tariff measures with their complex nature the paper analyses these indirect implications of encompassing trade policy instruments in the global economy. In a three stage approach, we quantify the cumulative impact of trade policy measures along the GVCs using the world input-output database (WIOD). In the first stage, we estimate bilateral import demand elasticities consistent with WIOD classification. In the second stage, we quantify the bilateral ad-valorem equivalents (AVE) of nine types of NTMs notified to the WTO by the end of 2011. Finally, in the third stage, we compute cumulative trade-restrictiveness indices (TRIs) using the AVEs of NTMs and tariffs taking into account backward linkages calculated with WIOD. The paper offers detailed TRIs for the inputs of 35 WIOD sectors to 41 economies from 2002 to 2011, which provides insights on the path of NTMs to the downstream industries and the final output.

## The dominance of the US and China in CO2 emissions growth through international sourcing

Topic: 711Y Special session: Analysing Environmental and Economic Consequences of Globalisation Using MRIO-SDA
Author: Sangwon SUH
Co-Authors: Rutger HOEKSTRA, Bernhard MICHEL

The effect of changes in trade patterns, particularly increasing international sourcing, on global CO2-emissions growth has yet to be clearly understood. Due to better availability of multiregional input-output tables and environmental data it is now possible to analyse in greater detail the influence of various globalisation trends on the shifts in emissions.

Hoekstra et al (forthcoming) estimated the Emission Cost of Sourcing (ECS), which originates from replacing domestic products by imports from countries with more CO2-intensive technologies. Using a structural decomposition analysis, it was found that changes in sourcing patterns between 1995 and 2007 contributed (1) to reducing territorial emissions in high-wage countries (70% of their territorial emissions growth), and (2) to increasing territorial emissions in low-wage countries (30% of their territorial emissions increase). The net global effect, the ECS, amounts to 18% of total global CO2-emissions growth.

In this paper we will use the method developed in Hoekstra et al (forthcoming) to analyse the US-China relationship, which is crucial for our understanding of global developments in CO2 emissions growth. Indeed, when looking at individual countries, it turns out that most of global

CO2 emissions growth through international sourcing is accounted for by the US and China. Our analysis quantifies the burden shift in the US-China relationship and looks at its implications for global CO2 emissions growth. The paper also discusses the results in the context of the Paris agreements.

## On the Interface between input-output and CGE models

Topic: 516C  Special session: Exploring the Interface between IOA and CGE
Author: Sangwon SUH

The Input-Output Analysis (IOA) and the Computable General Equilibrium (CGE) model have many commonalities as well as differences. Both describe the production and consumption of goods and services by multiple sectors, while general perception on the two models, which are largely based on archetypical versions of the two, focuses primarily on their differences in (1) sector/product resolution, (2) fixed-coefficients/substitution, and (3) handling of price effects.

At the same time, there have been many attempts that made the distinction more blurred. Furthermore, in recent years, environmental assessment community, Life Cycle Assessment (LCA) in particular, has begun exploring the use of IOA, CGE, and other models for "consequential" assessment, and the interest in the relationship between IOA and CGE is resurfacing. In this presentation, I propose to discuss the similarities and differences of the two, their strengths and weaknesses in answering different questions under different data/resource situations, and various attempts of crossover.

A number of case studies that are based on IOA, CGE, and the models interfacing them will be presented and discussed including the Rectangular Choice of Technology (RCOT) model, and its stochastic extension. I anticipate that the discussion will help sharpen our understanding of two modeling approaches, identify a set of unique roles of the two models in economic modeling, and guide the development of new approach that can embrace the strengths of the two.

## Comparing the tourism carbon footprint performance between Taiwan and Japan

Topic: 809Y  Tourism Industry Analysis
Author: Ya-yen SUN

Evaluation of the tourism carbon footprint has gained prominent attention in recent years as a means to document the environmental externality of tourism growth. Empirical applications range from the national analysis to regional scales, and from targeting a single industry to individual tourism events. The research scope of each study however varies by whether it includes all travel components into account (type of consumption), addresses direct and secondary effects of emissions (type of economic effects), and measures the impact of domestic tourism, inbound tourism or outbound tourism (type of visitor segment). Such differences make the cross-country comparison difficult, and limit our ability to identify the relative advantages in providing tourism services versus mitigating the greenhouse gas (GHG) emissions.

The balance between tourism’s economic benefits and its production of natural waste is especially critical for the Asia Pacific as this region has experienced strong growth rates of international tourist arrivals of an average of 6.1% from 2005 to 2014. This is roughly double the

world average, and international arrivals reached a historic high of 263 million in 2014. Among these countries, Taiwan embraces an annual growth rate of 18% while Japan reports a 29% growth rate of international visitors since 2011, rebound strongly from the Tohoku earthquake.

Therefore, purposes of this study are 1) to estimate the total tourism GHG emission in Japan and Taiwan based on a consistent evaluation framework, 2) to compare the tourism carbon efficiency (GHG emission/GDP) between Japan and Taiwan, and 3) to decompose total tourism greenhouse gas (GHG) emission in both countries to reveal the dynamics between economic growth, technology growth an environmental externality.

## Methodology

To perform a tourism CF assessment or decomposition analysis, a critical step is to define a clear system boundary for components being addressed. This study will adopt a top-down approach using the consumption scope of the Tourism Satellite Account (TSA) and the calculation approach of the Environmentally Extended Input-Output Model (EEIO) to trace domestic direct, domestic indirect and foreign-sourced carbon emissions. This includes all travel activities supported by national carriers (aviation, marine and land transportation), accommodations, food and beverages, culture, sports and recreation, travel agencies, and retailing services, as defined by the TSA. In terms of decomposition analysis, this study uses structure decomposition analysis (SDA) to measure the progress of technological development gains in energy consumption against the final demand changes. The preferred formula adopted in this framework is the "additive decomposition of the absolute indicator" method. Four factors that cause the tourism carbon footprint to change are identified as

1) Intensity effect: GHG emissions per dollar of final demand (a proxy for technological improvement),
2) Leontief effect: domestic (foreign) production structure,
3) Structure effect: visitor consumption shares by items, and
4) Final demand effect: aggregate visitor spending.

We further use index decomposition analysis (IDA) to provide insights into the modification of tourism eco-efficiency. The additive form of "logarithmic mean Divisia index method" (LMDI) is applied. Two causes are identified as:

1) Intensity effect: GHG emission per dollar GDP by industry.
2) Structure effect: relative contribution of GDP by industry.

## Significance

Japan and Taiwan are island countries, sharing several commonalities in tourism development. Both destinations extensively reply on aviation services for international travel where aviation is energy intensive and critical for the tourism emissions. Also, both areas experience a fast tourism growth rate annually. These factors are critical in tourism carbon footprint measurement, and at the same time, demonstrate that tourism energy use at both regions will be expected to increase substantially. This implies the need for each nation to take responsibilities in mitigating the tourism greenhouse emissions. Based on these considerations, this research attempts to establish the baseline information, and further compare the tourism carbon efficiency between Taiwan and Japan using the same evaluation framework. This research aims to identify key factors that determine the tourism carbon footprint as well as to reveal the different comparative advantages inherited within each country. Only by understand these components will strategies can then be developed to improve our current status quote.

## Evidence of energy efficiency improvements in Thailand's manufacturing and transport sectors using structural decomposition analysis

Topic: 514B  Structural Decomposition Analysis
Author: Tharinya SUPASA
Co-Authors: Shih-mo LIN

The economy of Thailand has been growing rapidly since the 1980s. Consequent to the fast growth of the economy was a remarkable increase in energy consumption to the extent that domestic energy production was insufficient to cope with the energy demand. Therefore, Thailand's energy supply has relied on fossil fuel imports, which means greater insecurity for future economic development. The government has, thus, enforced energy conservation policies for designated manufacturing industries and large buildings since 1995. These policies aim to encourage these designated groups to use energy more efficiently and reduce their energy consumption. Therefore, the effectiveness of the energy efficiency policies is evaluated by implementing an input–output approach. The results reveal that there is evidence of energy efficiency improvement in the Thai economy during the 1995 to 2010 period. The energy intensity of the transport sector was higher than that of manufacturing in both of our selected years. In contrast, the manufacturing sector actually consumed more total energy. The structural decomposition analysis revealed that the factors stimulating increases in energy consumption were the gross domestic product and population growth. Conversely, energy efficiency improvements and economic structural changes were the factors offsetting the increases in energy consumption. To sum up, the implementation of energy conservation policies has achieved an effective outcome.

## Inter-Sector Inter-Region Energy Model: Estimating Investment Projects in Energy Sector of Russian Economy

Topic: 516Y  Energy IO Modelling (2)
Author: Nikita I. SUSLOV
Co-Authors: Vladimir BUZULUTSKOV

The paper discusses an approach to a long-term inter-sector and inter-regional analysis of interactions between a national economy and its energy production segment.  It is based on an optimization multi-sector multi-regional model (OMMM) which includes a natural block of energy production, processing and transportation (OMMM-Energy) .  At present, this version combines 45 products of different economic sectors including 8 ones of an energy sector (rough oil, gas and coal, two kinds of petroleum products, coal processing, electricity and heat), and 6 Russian macro-regions; it is a composition of two sub-models for 2 time periods: 2008-2020 and 2021-2030. Each of the sub-models treats time changes in simplified manner – it means that all the variables are defined for the last year of the period and the variables of the basic year are fixed as exogenous ones.
The dynamics of investments into fixed capital is treated as non-linear functions being adapted with the help of linearization techniques.
A basic advantage of the OMMM-Energy is a combination of different approaches such as the input-output, inter-regional and energy balances. This allows evaluating the complex effects and efficiencies of the policy measures undertaken in the spheres of production, processing and consumption of energy. Previously, the model was applied to evaluating economic consequences of the:

- concentration of energy-intensive productions and gasification in the South Siberia regions;
- fast development of nuclear energy in the national economy;
- a reduction of energy intensity of production in the national economy;
- wide application of heat pumps technologies in the different regions of the national economy;

and many others but less significant issues.
The next section of the paper briefly describes a history of how the Soviet Union applied and later Russia continued to apply the input-output interregional analysis and OMMM, and what are their basic characteristics in comparison with IO, IRIO and MRIO approaches. The section 3 discusses both methodology and history of developing the original OMMM resulted in an OMMM-Energy version of the model. The sections 4-5 are devoted to setting and analyzing the problem of energy intensity in Russia and other world economies which we call “Energy intensity puzzle”. Section 6 presents some results of our analysis conducted by applying the model, and finally, the last section presents our conclusions.
The latest calculations carried out on the basis of OMMM-Energy were aimed at identifying permissible and economically justified cost limits of installed electricity generation facilities using renewable energy sources (RES). We made several variants of calculations for each of the region specified in OMMM-Energy to analyze how power generation from renewable sources (RES power generation) could impact on the national economy and regions of such power generation. The technique applied is – the different technologies of RES power generation (RES technologies) were incorporated into the models; on the base of priori guesses, the upper bound of a presumable volume of power generated by untraditional capacities were set; investment intensities of power generation were set with their initial values referred to standard power generation technologies used by traditional thermal stations; and then investment intensities were step-by-step increased to the level when the RES technologies become uncompetitive to traditional ones and, therefore, unavailable in the solution of the problem. So, two ranges of costs per unit of generation capacity were obtained for each region. The first one is such that power generation from renewable sources is obviously efficient and its application is limited only by technological and natural conditions. Another range is that one when RES technologies can compete with traditional ones and the choice of sources and RES technologies depends on the certain technological, natural, and economic conditions.
To summarize our RES generation efficiency analysis, we have found out that there are two levels of justified cost limits of installed electricity generation for the regions included in the model. The first one equals to USD 2100 per 1 kW, which equals to USD 2100 per 1 kW, which means that, given the estimated long-run average conditions, the production technologies of electric energy derived from RES requiring investment per 1 kW that are lower the specified level seem to be economically feasible and could dominate traditional generating technologies. Thus, their application is constrained rather by technical and natural conditions. The second level of cost limits equals to USD 3100 per 1 kW for European Russia and up to USD 3900 for Western Siberia.

## The Effects of Optimal Production Resource Reallocation on Carbon Footprint of Nations

Topic: 516F Environmental IO Modelling (2)
Author: Hirotaka TAKAYABU
Co-Authors: Shigemi Kagawa, Hidemichi FUJII, Shunsuke MANAGI

Climate change is a crucial problem for our society and all the countries need to effectively reduce the greenhouse gas emissions such as CO2 emissions by improving their production technologies. An important question is how production technology in a specific country is

environmentally and economically efficient in the sense that desirable outputs are maximized, whereas undesirable outputs (i.e., CO2 emissions) are minimized, referring to the production technologies of other countries.

The Data Envelopment Analysis (DEA) has widely used in addressing this problem. A recent important study by Fujii and Managi (2015) used the World Input-Output Tables during 1995 to 2009 and estimated the effects of reallocating production resources on the emissions reduction. They also found that basic material industry have a great potential to reduce the emissions. However, Fujii and Managi (2015) did not estimate the emissions embodied in final demand of countries (i.e., consumption-based emissions) under the world optimal production structure found in the DEA framework and they did not evaluate how consumption-based emissions under the optimal world production structure differ from ones under the actual world production structure.

Firstly, this study identified the set of efficient production technologies (i.e., production frontier) of 10 manufacturing sectors using the DEA framework considering domestic output as a desirable output, CO2 as an undesirable output and intermediate inputs. Data of World Input-Output Tables of 40 countries during 1995 to 2009 is applied. Then we estimated consumption-based emissions (i.e., carbon footprint of nations) using the actual World Input-Output Tables and ones using the modified World Input-Output Tables that include optimal sectoral outputs and the emissions estimated by the DEA. From the results, we found that chemical and steel sectors are inefficient in some countries like China in the sense that those technologies can increase outputs and simultaneously reduce CO2 by shifting their inefficient production activities to the production frontier.

We finally conclude that consumption-based emissions can reduce considerably by reallocating production resources referring to the production frontiers of 10 manufacturing sectors estimated by this study.

## Energy Balance in India's International Trade: An Input-Output Based Analysis

Topic: 514Y  Energy IO Modelling (1)
Author: Anjali TANDON
Co-Authors: Shahid Ahmed

Regardless of the impact on environment, whether positive or negative, literature recognizes the growing volume of trade and the emissions (due to energy use) embodied in trade. Although studies acknowledged the importance of non-energy manufactured goods, the growing integration of international supply chains further emphasizes role of international trade in the changing energy use. In view of the increasing emissions embodied in trade, it is not appropriate to make sweeping generalizations on the impact of trade on environment. The energy balance due to embodied use could be significant for trade dependent economies. Also, it is difficult to predict ex ante the direction of energy balance for countries with varied compositions of exports and imports in terms of energy intensity of the traded products. And, India is a befitting case here due to the dissimilar structure of its exports and imports. We estimate the balance of embodied energy in India’s international trade to study the key research objectives for the Indian economy: i) Are the energy balance and trade balance necessarily in same direction, ii) How has the energy balance performed over time with increasing openness of the economy,  and  iii) What are the sector-wise contributions to energy balance. The creation of a separate sector representing non-thermal electricity for analysis is another contribution of the present research. Non-thermal

electricity, which essentially represents hydro electricity, has an increasing significance in the Indian economy. Although, electricity per se is not traded significantly in India, its embodied use across sectors of production improves the estimates of energy balance. Most existing studies exclude an electricity sector for analysis due to its dominantly thermal based generation. However, the present paper makes novel efforts to separate out the non-thermal component which is likely to expand in future given the growing emphasis on sustainable growth. The use of separate price deflators for output, export, imports and intermediate use for each of the sectors of analysis, is another highlight of the paper which is useful to obtain improved estimates. Also, the analysis has a sufficiently wide reference period which facilities inter-temporal comparison. The methodology of this paper makes use of hybrid I-O as formulated by Miller and Blair (2009). Based on the location of the production and consumption of a commodity, products are classified into four categories (Lin and Sun, 2010). The energy and energy intensive sectors are identified for the analysis. The analysis is based on the four successive benchmark IOTTs. While it is a common practice to deflate the values of aggregated sectors, we have computed, mapped and obtained deflators for each of the 130 sectors. This is further helpful in obtaining robust price indices in instances where the commodities within a sector have noticeably different values of the price index. Our results for India at the aggregate level show overall deficit in energy balance as well as the trade balance through the reference period. Despite a higher value of energy embodied in overall imports (EEI) compared to energy embodied in overall exports (EEE), the growth rates provide an interesting insights. It is observed that over time, the composite energy sector has turned from an energy deficit to energy surplus category. This is primarily on account of India’s expanding petroleum sector which registered growing exports. On the contrary, non-energy sector has turned into a energy deficit though it had a relatively insignificant energy surplus in the initial period. This points to the importance of embodied energy in traded goods.

## Productivity and Efficiency in the Handbook of Input-Output Analysis

Topic: 711D Productivity and Efficiency (1)
Author: Thijs TEN RAA

The Handbook of Input-Output Analysis is now edited, by me. Drafts of productivity analysis (the chapter by myself) and efficiency analysis (the chapter by Victoria Shestalova) will be presented.
Input-output coefficients, the amounts of inputs required to produce outputs, are a useful tool for impact analysis (involving input-output multipliers) and imputations (involving factor contents, e.g. in international trade and ecological footprints). I relate input-output analysis to productivity analysis.
Conceptually, productivity is the amount of output produced per unit of input, i.e., the inverse of input-output coefficients. This relationship is made precise, in a way that consolidates the input-output literature on productivity and efficiency. Statistical offices present input-output tables on the basis of industry totals, which amount to taking averages. However, the idea of Leontief has been that the coefficients represent technology. Besides averages best practices better enter the calculation. This distinction facilitates the measurement of inefficiencies.

## Measuring Industrial Upgrading in Global Value Chains: A Latent Variables Approach

Topic: 811Z International Trade (2)
Author: Kailan TIAN
Co-Authors: Erik DIETZENBACHER

A key question for promoting international competition is how to improve the position of nations and industries in global value chains (GVCs). The first step is to properly measure industrial upgrading in GVCs. This is not a trivial issue because upgrading has not been defined unambiguously. Several authors have used different (and sometimes related) measures, all of which are indicative of (certain aspects of) upgrading. Rather than trying to find the single, ultimate definition and measurement of upgrading, this paper proposes a different type of framework. We examine the multidimensionality of industrial upgrading, using nine existing indicators for upgrading in an Exploratory Factor Analysis. The indicators all adopt the GVC perspective and include, for example, the growth in market share of value added exports and the growth in high skilled workers involved in GVCs. We find that industrial upgrading has three dimensions: productivity upgrading, chain upgrading, and skill intensity upgrading. Finally, with these dimensions, we compare and analyze the upgrading of different countries and industries using WIOD tables.

## Measuring Economic Impact of Tourism toward Poverty Alleviation in Indonesia: An Input-output Analysis

Topic: 809Y Tourism Industry Analysis
Author: Oscar TIKU

This study has objective to comprehend the economic impact of tourism toward poverty alleviation in Indonesia. Input-output analysis will be primarily used to examine the impacts of tourism. The researcher is going to reclassifies Indonesia’s input-output sectors, with an emphasis to the major-related tourism sectors, where later will be tied and labeled as a tourism major-related industry.
This research consisted of two phases, where the analysis will be firstly focused on tourism impacts on the economy, and next the second phase where it will be further linked to poverty alleviation. The impacts of tourism major-related industry existence in the economies will be scientifically measured and multipliers in output, employment and income are going to be identified. Furthermore, its impact to poverty alleviation, which in this case will be observed on poor people’s spending pattern.
Indonesia’s input-output table in 2010 which was just published to public at the end of December 2015 will be mainly used in this research. As well as supporting data of income demographic, tourism outlook, data of national socioeconomic census, etc. There were some previous researches which analyzed the impacts of tourism to the economy in national and regional level in Indonesia, but research whose linkage to poverty alleviation has not identified yet.

Keyword: tourism, input-output, Indonesia, poverty alleviation

## Regional Net-Impacts and Distributive Effects of Promoting Renewable Energies in Germany

Topic: 711F  Inequality and Environment
Author: Johannes TÖBBEN

This paper concerns the net-effects of promotion the promotion of renewable energies on value added and disposable income in Germany, as well as their distribution among regions and income-brackets. Since its entry into force the German Renewable Energies Act (EEG) stimulated tremendous investment into renewable energy capacities through guaranteeing investors a fixed price per kWh as well as preferred feed into the grid over electricity from conventional sources. The policy measures are financed by surcharge on electricity prices. In recent years a controversial debate arose about potentially negative regional and social distribution effects. In this paper, multiregional price and quantity Input-Output models with endogenous heterogeneous households are used to trace the indirect impacts of the EEG on output and income levels (quantity-side) and the formation of prices and wages through a complex network of regionally dispersed value chains. Our findings suggest, that generation of electricity from renewable sources itself leads to small positive impacts on industries, but leads to a massive drain of household’s income and has regressive distributive effects. However, investment into new capacities is found to turn negative impacts into a positive direction for the majority of households.

## On the Simultaneous Estimation of Physical and Monetary Commodity Flows

Topic: 811Y  LCA and Industrial Ecology (1)
Author: Johannes TÖBBEN

Large-scale databases mapping commodity flows measured in various units such as currency, tons or caloric values build the base for many recent environmental-economic studies. Their construction typically requires combining large amounts of partial information in a series of successive steps. These include the estimation of unobserved flows, their transformation from one unit into another, harmonizing differing levels of aggregation and mismatching classifications and, finally, reconciling estimates with mass-, financial- and/or energy-balances. This paper proposes a maximum entropy model that allows for the simultaneous estimation of unobserved commodity flows measured in physical and monetary units from limited information. The model assembles compound commodity flows from products at high resolution and diverse prices such that data constraints in various units of measurement, levels of aggregation and possibly mismatching classifications are simultaneously satisfied. Its capability is demonstrated in terms of a real-sized application to the estimation of interregional trade flows in Germany.

## Singapore’s Trade in Value Added: Importance and Implication of Information from the OCED-WTO TiVA Database

Topic: 516D  Trade in Value-added
Author: Mun-Heng TOH

The OECD-WTO) Trade in Value-Added (TiVA) database was made public recently and has been used in many policy-oriented studies. The key input in the OECD-WTO database is the sets of international input-output tables that enable standard input-output techniques to be applied to decompose and elucidate the value-added content of gross export of a country. An important contribution is its ability to enable a better understanding of how a country participate in the global value chains (GVCs), the importance of trading in intermediate products, complementarity of imports and role of services in completing the international commerce transaction.

Singapore is an active participant in the GVCs and global production network (GPN). This paper made use of the published tables from the OECD-WTO database together with other local information to evaluate how the approach of considering trade in value-added may have on Singapore’s development strategy which is predominantly based on trade openness and liberal inflow of foreign direct investments. There are also expected implication on issues such as rules of origin and service trade liberalization in the negotiation of free trade agreements (FTAs). Singapore has a relatively large network of regional and bilateral FTAs to support and facilitate its participation in the GVCs.

## Analyzing Structural Changes in the CO2 Emission Clusters within Global Supply Chain Networks

Topic: 811F  Network Analysis for Environment
Author: Shohei TOKITO
Co-Authors: Shigemi Kagawa

Global CO2 emissions continue to increase and the improvement of environmental efficiency at industry level is needed in many developed and developing countries (Kagawa et al., 2015). The CO2 emissions embedded in international trade have rapidly increased in countries with lax environmental regulations (Peters et al., 2011).

With this background, Kagawa et al. (2015) used World Input-Output Table (WIOT) of 2008 and identified 4756 significant CO2 clusters from global supply-chain networks associated with final demand of countries. In addition, they found that U.S. transport equipment and construction demand generated relatively-large CO2 clusters in China, accounting for 17% and 10%, respectively, of the U.S. CO2 footprint. However, the previous study did not focus on the structural changes in the CO2 clusters over time and it was limited to analyzing CO2 clusters for only 2008. As a result, Kagawa et al. (2015) did not address the following questions: how the global CO2 clusters have formed over time and which supply chain partners (i.e., stakeholders in this study) have played an important role in changing the relatively-significant CO2 clusters over time?

This study identified CO2 clusters by applying the nonnegative matrix factorization method (Kagawa et al., 2013, 2015) to the adjacency matrices based on the environmentally-extended World Input-Output Tables during 1995 to 2009 (Dietzenbacher et al., 2013) and found key sectors by applying betweeness centrality method (Freeman, 1979) to the same matrices. The

results based on the clustering analysis and centrality analysis show that (1) CO2 clusters in China generated by the U.S. construction demand have rapidly expanded during 1995 to 2009 and (2) Chinese steel industry was a major hub sector in expanding the Chinese CO2 clusters induced by foreign final demand. We suggest climate policy of reducing CO2 emissions in the clusters through decreasing emission intensities of the hub sectors identified in this study.

## The statistical structure of the US input matrices: 1947-2007

Topic: 714Z  IO Accounts and Statistics (2)
Author: Daniel TORRES
Co-Authors: Jangho Yang

This paper conducts a large scale study of the statistical characteristics of industry-by-industry input coefficient matrices A=[aij]. The review of the literature shows that there is a common use of probabilistic assumption in their IO models together with a lack of information on the statistical properties of actual IO matrices. Using the US Benchmark Input-Output accounts, for the 60 years period from 1947-2007, and at the most detailed level possible, we find a series of statistical regularities in several elements of A and of its spectrum. We compute frequency distributions and other exploratory data techniques and find a statistical structure in these 12 matrices. A simulation analysis is performed and concludes that 5% of the aij coefficients are enough to replicate the statistical structure found for the whole matrix. The existence of these stylized facts provides crucial information for scholars working in a multi-sectoral linear models with probabilistic features and calls for explanations of the economic forces generating the statistical regularities.

## The relationship between labor, output and the interindustry input structure: an evaluation of Schefold's explanation of empirical wage-profit curves

Topic: 711B  Methodological Aspects of IO Analysis (1)
Author: Daniel TORRES

In a series of recent papers, Bertram Schefold has presented a particular representation of the Sraffian price system and advanced a set of hypotheses to explain the nearly linear behavior regularly found in empirical estimations of wage-profit curves. Based on a representation of the price system and the wage-profit curve in terms of Goodwin's Normalized General Coordinates (NGC), this paper shows that there is an inconsistency in Schefold's “strong normalization” assumption and his hypotheses, which rely on a random conception of the input coefficient matrix, and the labor and output vector. Moreover, this strong normalization assumption ignores a set of economic forces that affects the behavior of the price and the wage as a function of the profit rate, which do not depend exclusively on the eigenvalues of the input matrix. The representation of the price system in terms of NGC reveals the general conditions for the linearity of these functions and shows that 1) Schefold's hypotheses and assumptions do not lead to a linear wage-profit curve and that 2) the relationship of the labor and output vector with the interindustry flow structure, represented by the input coefficient matrix, are other factors that must be considered for explaining the observed near-linearity.

## A Framework of Economic Loss Estimation due to Transportation Network Disruptions

Topic: 814B  Special session: Disaster Impact Analysis
Author: Satoshi TSUCHIYA
Co-Authors: Hirokazu Tatano

Recently, socio-economic impact of a disaster is enormous hitting urban areas in which population and asset are accumulated. Thus, we need to build up effective
integrated disaster risk management strategies for reducing economic losses. To this end, it is necessary to establish an analytical framework for estimating
indirect economic losses induced by disruption of transportation networks or dysfunction of other infrastructure.
Comprehensive economic modeling framework such as input-output analysis and computable general equilibrium (CGE) model is widely used to accomplish the above purpose. The spatial CGE model (SCGE model), which is extended from CGE model into multi-regional framework, is such a promising one that it can entail not only inter-industry relationship but also inter-regional commodity flow. However, it still remains some challenges: e.g. description of intra-regional transportation flows and traffic congestion in a disaster. In order to solve the problem, this research aims at showing a framework which integrates SCGE model and traffic assignment on transportation networks, and at applying a suggested framework for economic loss estimation due to transportation disruption scenarios from a great earthquake scenario.
An idea of the research is as follows. SCGE analysis provides interregional commodity flow as one of outputs. It can be regarded as traffic demand (OD traffic volume), and we convert figures in an appropriate manner, decomposing a region in SCGE into several zones in traffic assignment. After preparing OD traffic volume based on the inter-regional commodity flow, traffic assignment is carried out by user equilibrium concept. As a consequence, we will obtain inter-zonal travel time.
Aggregating into inter-regional transport time for the SCGE model, it is used as an input for the SCGE analysis. An economic equilibrium is calculated under a new
input value, providing again a set of interregional commodity flow. Continuing this cyclic process, the equilibrium state will finally be found in this integrated model.

## Public Debt in the Flow-of-Funds Perspective

Topic: 716A  Special session: Flow of Funds Data and its Applications (2)
Author: Masako TSUJIMURA
Co-Authors: Kazusuke TSUJIMURA

Since the global financial crisis of 2008-2009, public debt in advanced economies has increased substantially. High levels of debt in mature economies are a relatively new global concern, after decades of attention on debt levels in developing and emerging countries. Four Eurozone countries, Greece, Portugal, Ireland and Cyprus have turned to IMF and other European governments for financial assistance in order to avoid defaulting on their public debts. There are also concerns about the sustainability of public debt in Japan and the US, and more recently, also in the major European countries. As of the end of 2015, the stock of gross central government debt exceeds annual nominal GDP in five OECD countries: Japan, Greece, Portugal, Italy and Ireland. The ratio of the former to the latter is over 80% in seven more countries: United States, United Kingdom, Belgium, Spain, Iceland, France and Slovenia. In the past, people blamed the governments for the high public debt–GDP ratio; however, more recently, they began to notice that the real cause lies in the saving-investment imbalance in the private sector rather than in

the lax fiscal policy of the government.
Over the past decades, a combination of diverse forces has created a significant increase in the supply of saving in the mature economies — a saving glut. One well-understood source of the saving glut is the strong saving motive of rich countries with aging populations, which must make provision for an impending sharp increase in the number of retirees relative to the number of workers. With slowly growing or declining workforces, as well as high capital-labor ratios, many advanced economies face an apparent dearth of domestic investment opportunities. If a country's saving exceeds its investment during a particular year, the difference represents excess saving that can be lent on international capital markets. As a consequence of high desired saving and the low prospective returns to domestic investment, the mature economies as a group seek to run current account surpluses and thus to lend abroad. On the other hand, if a country's saving is less than the amount required to finance domestic investment, the country can close the gap by borrowing from abroad. Actually, in the past, national saving in major emerging economies was low and fell short of the capital investment so that they heavily borrowed in the international market.
However, after the 1997-1998 financial crisis, there has been a remarkable reversal in the flows of credit to developing and emerging-market economies, a shift that has transformed those economies from borrowers on international capital markets to large net lenders. The matured economies can no longer find sufficient international lending opportunities. In a quasi-closed economy, a country's domestic investment in new capital and its domestic saving need be equal in each period; the only way to accommodate the private sector excess saving is to absorb it by the public deficit. If there are enough needs for public investment, the saving and investment will balance in the national economy that includes both private and public sectors. If there are not enough opportunities for public investment, the government has no option but to use the raised funds to close the current fiscal gap, which means offsetting the private-sector savings by the public-sector dissavings.
We will mainly use the National Accounts of the OECD Countries to review the relationship between the private-sector saving-investment imbalance and the public debt for each countries. We can observe the saving-investment imbalance both in the non-financial and financial accounts. In the non-financial account, saving-investment imbalance is defined as the difference between saving, which is derived as disposable income less final consumption expenditure, and net acquisitions of non-financial assets. In the financial account, net financial transactions is defined as the difference between the acquisition of financial assets and the incurrence of liabilities. The SNA refers both saving-investment imbalance and net financial transactions as net lending/borrowing because they are theoretically equivalent. If this balancing item is negative for the public sector as is the case in most of the mature economies, there are two possibilities: either gross saving is positive or negative. While the former is the case of excess investment, the latter is the case of negative saving of the public sector.

## Waste generation embodied in international trade between China and Japan : China-Japan WIO Analysis

Topic: 814E  Special session: Economic and Environmental Relationship in Asian-Pacific (2)
Author: Makiko TSUKUI
Co-Authors: Chen LIN

China’s rapid development since adopting reform policies and opening its doors in the 1990s has brought about a dramatic increase in environmental loads, such as GHG emissions, air, soil and water pollution, and waste generation, all of which are serious environmental problems. Numerous studies have demonstrated that Chinese exports to other countries are among the

main reasons underlying the environmental problems in China. While some of these studies have quantitatively investigated consumer responsibility for the environmental problems in China, most have focused on carbon footprints, water footprints, and energy consumption. Indeed, few of these studies have attempted to clarify the effect of waste management activities on the generation, transportation and treatment of waste. As a first step in investigating these issues, we examined how exports from China to Japan contribute to increased environmental loads in China. Specifically, we quantitatively clarified the economic and environmental relationships between China and Japan using a China-Japan interregional waste input-output (CJIRWIO) table for the year 2007.

In the CJIRWIO table for 2007, the goods and services sectors in China and Japan were compiled using “The Japan-China International Input-Output Table 2007” published by the Ministry of Economy, Trade and Industry (METI), Japan. However, the waste categories for China and Japan varied depending on the sources used for the statistics for each country; for the Japanese waste categories we used the “Industrial Waste Generation and Treatment Survey 2007” published by Ministry of the Environment, Japan, and for the Chinese categories we used the “China Statistical Yearbook on Environment 2008”, the “China Classification Garbage Statistics” and the “China Statistical Yearbook for 2008” published by the National Bureau of Statistics of the People’s Republic of China. In Japan, industrial waste is categorized into 19 categories, while in China there are only four industrial waste categories.

According to results obtained from the CJWIOT 2007, the difference in the scales of the economies of China and Japan is not as large as that in the amounts of waste generated. The GDP of Japan, including the activity of the waste treatment sectors, was 8.2 trillion US dollars, and that of China was 11.3 trillion US dollars in 2007. The waste generated by the industrial sectors in China is about 1.5 billion tonnes, which is about five times larger than that generated in Japan. In Japan, “Livestock excreta” from the “Agriculture” sector and “Construction waste” from the “Construction” sector are large. In China, “Mining”, “Electricity gas, and heat supply”, “Metals” and “Chemical products” are the predominant industries that generate large amounts of waste. The repercussion effects of final consumption by Japan on China induce large environmental loads, which are accompanied by considerable economic effects. The final demands of China and Japan induced almost the same production values in each country. The estimated production value induced in China by the final demand of Japan is about 244 billion US dollars, and that induced in Japan by the final demand of China is about 228 billion US dollars. However, the final demand of Japan induced about 215 million tonnes of CO2 equivalent of GHG emissions in China, which is about four times larger than the final demand of China induced in Japan. The final demand of Japan also induced 50 million tonnes of waste in China, which is about five times larger than the final demand of China induced in Japan. So, final consumption in Japan brings about large economic repercussion effects in China, and these are accompanied by large environmental loads. Although there are issues with the Chinese statistics, the Chinese government understands that a large amount of waste is generated in the country. It is also very important for the governments of both countries to cooperate in order to reduce environmental loads.

## Potentials for a circular economy – assessment with Exiobase V3

Topic: 514Z  Special session: Compilation and Application of EXIOBASE 3 – a time series of highly detailed EE MRIOs
Author: Arnold Tukker
Co-Authors: Arjan de Koning, Jannick Schmidt, Konstantin STADLER, Richard WOOD

Making our global economy more circular will reduce the need for primary resource extraction, and is hence an important policy agenda in countries and regions such as the EU, China and Japan. One of the unique featurs of the third version of EXIOBASE as developed in the EU FP7 DESIRE project is that it is not only a traditional global MR EE IO, but also shows all economic relations in physical terms. On top of this, for each country waste treatment is represented by a fairly detailed physical SUT/IOT. EXIOBASE V3 further gives time series from 1995 to 2012/13, with now-casted data till 2016.
This detailed insight in physical flows including various forms of waste management allows deriving insight in the following. First, we can analyse the level of re-use and recycling in a specific year across countries. Second, we can analyse changes in the level of re-use and recycling over time. This, in turn, allows by country to assess the amount of final waste output versus primary resources input, which indicates the level of 'circularity' a specific country has arrived at. Further, by analyzing which country has 'best in class' performance, and assessing with which speed countries move towards a more circular economy, educated guesses are possible what levels of circularity can be expected in medium term (e.g. assuming that in 10-15 years all countries will have 'best in class' performance, or assuming an ongoing improvement trend as given by time series analysis.

## Geographical keyword: From Brazil via Congo to Outer Space

Topic: Guess Who on What? ...Lot B
Author: ... absolutely secret until the day !!!

## Geographical keyword: The World

Topic: Guess Who on What? ...Lot A
Author: ... absolutely secret until the day !!!

## Geographical keyword: Europe

Topic: Guess Who on What? ...Lot B
Author: ... absolutely secret until the day !!!

## Geographical keyword: The U.S.

Topic: Guess Who on What? ...Lot A
Author: ... absolutely secret until the day !!!

## Accounting for dualistic production technologies in input-output analysis

Topic: 811Z  International Trade (2)
Author: Chakrin UTIT
Co-Authors: M. Yusof SAARI, Nur adilah HAMID

Why growth in final demand does not bring considerable implications on structural changes and income equality in Malaysia? What are the factors that can be put forward to explain the lower impacts of economic growth? The current input-output models are unable to provide explicit answer to these questions because they ignore dualities in production technologies. The major limitation of the models is production sectors are aggregative and thus homogeneity biases underlying in the models could not be avoided. In particular, one might get a false impression that development in some sector will “trickle down” to benefit all equally. What is needed is a systematic methodological approach that links the different dualistic production structures. This paper aims to develop a new approach for input-output model that split the production technologies according to firm sizes—small, medium and large firms. To develop the model, the production sectors in the input-output table will be separated according to group of small, medium and large firms. This paper has two main contributions to the literature. First, it develops new database that differentiates economic sectors according to the technologies and links them consistently in a single macroeconomic framework. Second, using the database, a number of novel empirical applications that aim to validate the homogeneity assumption and the extent to which the different production technologies affect value added and income inequality.

## Complementarity, sustituibility and rivality in trade between South East Asian and Latin-American countries

Topic: 716D  Special session: Asian Trade with Latin America: Impact and Evolution
Author: Marcel VAILLANT
Co-Authors: Enrique GILLES

The main goal of the paper is to characterize structural pattern of trade of South East Asian and Latin American Countries. With this information we can have elements to make some predictions about the impact of the set of trade agreements developed among countries of both regions. Differentiated inside countries and outside countries of trade preferential agreements. The methodology we are going to apply combine a network approach with conventional trade specialization index of relative comparative advantage (and disadvantage). International trade can be represented as a bipartite network connecting products with countries, where a link exists if a country exports a product with Revealed Comparative Advantage (RCA). Projecting this bipartite network on the products partition, Hausmann, Klinger, Barabási and Hidalgo (2007) developed the notion of Product Space. Then, Flores and Vaillant (2013) presented a new version of the Product Space with two major extensions of this framework. First, they consider the alternative projection of the bipartite network on the countries partition, building what we call the “Country Exports Space” (CXS). Second, they replicate the same procedure to the imports

bipartite network and present the “Country Imports Space” (CMS). These two spaces are representations of the similarities among the baskets of products that countries import or export. Recently Flores (2015) introduce the concepts of complementarity, substitutability and rivalry with permits a deep knowledge of structural trade relationships among countries. Trade specialization indexes calculations were conducted using BACI International Trade Database from CEPII (Gaulier and Zignago, 2010), with bilateral trade consistency-corrected COMTRADE data for almost 5.000 products (Harmonized System subheadings) and 167 countries. In order to obtain more robust results, we use the mean trade values for the four-year period 2009-2012.
This type of research analysis is new for the evaluation of bilateral trade relationships influenced by preferential trade agreements. Also could be linked with input output analysis to improuve the quality of the assumption of the sectoral destiny of the imported products (the missing index).

## The role of Dutch SMEs in the Dutch economy: An analysis using an extended SUT

Topic: 716W Special session: APEC TiVA: SUTs with Firm Heterogeneity (2)
Author: Marcel VAN DEN BERG
Co-Authors: Stephen Chong, Rutger HOEKSTRA, Oscar LEMMERS, Ilke Van Beveren, Ron Van der Wal, Piet Verbiest

It is well known that SMEs and large enterprises can have very different behaviour. For example, the first group is less prone to export, one of the reasons being that it cannot bear the costs for entering foreign markets. However, an analysis using standard input output tables does not take this heterogeneity into account because industries are not split by SMEs and large enterprises. Thus, the contribution of SMEs to exports, their opportunities to benefit from growing markets abroad, are underestimated. This heterogeneity is recognized by many and organisations such as the OECD have set steps to develop new data and insights. However, at the moment the necessary data to take heterogeneity into account are scarce. This paper describes a project that fills that gap, namely the development of a SUT and IOT for the Netherlands split up by four size classes.

We introduce heterogeneity in the Dutch SUT and IOT of 2012 by splitting them into four size classes. Then the usual techniques are used to estimate the contribution of SMEs to total exports and to the ten major trading partners of the Netherlands respectively. Such a contribution can be by direct exports or by supplying large enterprises with intermediate goods and services that are subsequently used to export.

The existing Dutch SUT is split up using information from several statistics on enterprise level. For example, turnover, investments and exports. Using the General Business Register the aggregates of these variables are computed for the four size classes. Then they are plugged into the standard systems of National Accounts which yields the first version of the desired SUT where most industries are split up in four size classes. It is checked for plausibility and adapted when necessary. The final version of the SUT is used to construct an IOT where most industries are split up in four size classes as well. The IOT is checked for plausibility and adapted if necessary.

Subsequently, the IOT is used to derive the role of SMEs in the Dutch economy. How much are their activities intertwined with those of large enterprises? For the first time we can properly estimate this in general and for exports in particular. This provides new information about the channels that SMEs use to export; are they mainly direct suppliers of foreign markets or mainly suppliers of large enterprises that export. This estimation is made for exports to the ten main

trading partners of the Netherlands. Since it can be expected that there is heterogeneity in export markets as well. It is easier for SMEs to export to neighbouring countries Germany or Belgium than to countries far away.

A novelty in our project is the delineation of SMEs. Instead of considering enterprises that have a domestic workforce less than 250 employees, we consider enterprises that belong to an enterprise group that worldwide has less than 250 employees. Thus, a small Dutch subsidiary of a foreign multinational is not considered to be an SME. This definition is much closer to reality. Since such a subsidiary has access to a large network, knowledge and finance, just as a large enterprise, whereas the average SME does not. However, the construction of the SUT and IOT is in such a way that the traditional delineation of SMEs can be used for calculations as well. This makes it possible to compare the results to earlier studies about the role of SMEs in the Dutch economy.

## The impact of the new ESA rules on Goods for Processing and Merchanting on the Belgian SUT and IO tables

Topic: 711Z  Special session: Compilation Issues of Supply, Use and Input-Output Tables
Author: Bart M. J. VAN DEN CRUYCE

According to the rules of the ESA 2010, flows of goods related to international processing are to be excluded from imports and exports, leaving only a net flow for the value of the processing service. Moreover, goods purchased and sold abroad by a resident trader that do not cross his own countries' borders (merchanting) are now included in imports and exports. Both changes with respect to the ESA 95 reflect the priority given to a change in ownership over the physical flows of goods. This is an issue of great concern for many users of IO-tables.

This paper shows how these changes in ESA-rules have been implemented in the Belgian Supply and Use and Input Output tables for 2010. To compute their impact, starting from the ESA 2010 version of the 2010 tables, a variant SUT and IO table is derived, using available trade data, in which the former ESA 95-rules for international goods processing and merchanting have been applied. This is preferred to directly comparing the existing ESA 95 and ESA 2010 versions of the tables which differ too much due to an occasional revision of the national accounts and other new rules introduced by the ESA 2010.

## Economic interaction, productive chains and formation of manufacturing clusters in the functional economic North Central region of Mexico: a case of regional input-output from the bottom-up approach

Topic: 811A  Regional IO Modelling (2)
Author: Cristina VAZQUEZ
Co-Authors: Normand E ASUAD, Krista Zafra

Economic and social reality in Mexico reflects wide inequialities. This situation urge to undertake regional analisis, to account for economic heterogeneity and its spatial components in order to correctly understand and analize economic fenomena, enabling the development of appropriate policies regarding territorially located problems. Currently, most of the studies that address regional disparities have focused on general macro analysis, with special emphasis on time

dimension and favoring the use of federal entities or states, which are administrative spatial units, for their analysis. However, it is required an integral approach that takes into consideration space through a functional economic perspective, highlighting the importance of the spatial structure of economic activity and the economic spatial units to which it gives rise, as a fundamental element to explain regional disparities.

This paper provides a study case on the economic interaction, identification of productive chains and formation of manufacturing clusters in the functional economic North Central Region of Mexico, starting with the construction of a regional input-output matrix from the bottom-up approach as a key methodological element of analysis. Regional accounts and analysis of economic interactions are needed for the construction of regional input-output matrix. To do this, the functional region is presented and the main economic subregions are identified, validating its economic interaction with spatial dependence, measured by Moran and Lisa indexes, then there are constructed economic accounts by subregion, focusing on key sectors. Subsequently, using the built matrix, manufacturing regional interactions will be identified, remarking performance of subregional spatial units. Finally the results will be linked to the identification of productive chains in the region and with the formation of manufacturing clusters, using in this stage, clustering techniques from network theory, for subsequent georeference based on interaction and economic specialization.

Thus, this research aims to identify the formation of manufacturing clusters in the region studied, in use of methods that consider the importance of space as an explanatory element. So, the research question of this paper is the following: What are the major manufacturing clusters in the North Central Region of Mexico and how their interaction occurs spatially through economic functional units?

Data for the construction of the regional matrix will be taken from the economic censuses 2014, as well as information available from statewide surveys and official sources (INEGI). Also, from the regional matrix built, manufacturing productive chains and clusters will be identified, using GIS (Geographic Information System) as tool.

The importance of this work lies in the novelty of the methodology, since for the Mexican case has dominated the construction of regional input-output tables from the top-down approach without considering the dominant regional economic structure and thus the economic heterogeneity that prevails in the country; so this research is a contribution on how the economy of a region works spatially therefore represents a valuable tool for decision making. In addition, adressing the formation of manufacting clusters from a economic and spatial perspective.

## Why there is large energy consumption variations between China and other countries: perspective from the final demand side

Topic: 716Y  Energy IO Modelling (3)
Author: Ce WANG
Co-Authors: Hua LIAO

Different countries follow various energy consumption patterns, directly due to such scale factors as economic scale and population size, but also on a deeper level, the underlying variation of the economic structure, including industrial structure and final demand structure. Different from most of existing researches, this study focuses on the final demand side and analyzes the energy consumption variation across the world, aiming to explore China’s heightening status in energy

consumption as well as its increment compared to that of other countries. This study employs a multiregional input-output model to calculate energy consumption embodied in various types of final demand and energy consumption multiplier for 40 economic entities between 1995 and 2009. Our findings are: i) in terms of the structure of energy consumption embodied in final demand, China was mainly driven by gross capital formation rather than residential consumption as other countries; ii) in terms of the trend of energy consumption embodied in final demand, China presented an increasing growth trend, while other countries, especially developed countries began to stabilize or decrease; iii) however, China had a lower level of final demand and energy consumption per capita than other countries; iv) China's energy consumption multiplier was higher than that of other countries, but China has made great efforts in energy conservation and emissions mitigation to narrow the gap.

## Multi-regional sub-national MRIOs for policy making in China: Using the Chinese MRIO Lab

Topic: 814W  Special session: Input-Output Virtual Laboratories (2)
Author: Yafei WANG

Significantly unbalanced development and heterogeneity across Chinese regions has been identified and acknowledged in various researches using Chinese multi-reginal input-output tables (MRIOs). However, all currently available Chinese MRIOs have low resolution, either at provincial or grand regions or broad sectors. None of them is available as further detailed regions and sectors. And at the time of their release the most recent tables are at least five years out of date. We use collaborative virtual laboratory concepts and its principle and integrate as much as possible Chinese official input-output tables, census data, and macro-aggregates to build a multi-reginal sub-national MRIO Lab for China. The innovation of this new Chinese MRIO lab is that it can generate regionally and sectorally very detailed tables based on users' own research questions. Our China Lab currently covering the longest and latest data can support central and local governments to make more specific policies for whatever detailed regions in China and also help to exam previous policies and guide better policy improvements.

## Financial footprint of nations: A global analysis

Topic: 711A  Special session: Flow of Funds Data and its Applications (1)
Author: Yafei WANG

The flow-of-funds matrices have been acknowledged as a key tool at the forefront of the financial risk debates. However, current flow-of-funds input-output models only focus on the single region or country and cannot reflect the multi-region ripple effects in the world. Considering the complexity of global financial risk network can help to effective risk reductions for countries. We develop a global flow-of-funds input-output table by combing the world multi-reginal input-output table with flow-of-funds matrices from all over the countries. This table distinguishes at least 40 individual countries including China with detailed sectors. It reconciles two main data resources named Coordinated Portfolio Investment Survey (CPIS) by International Monetary Fund and Consolidated Banking Statistics (CBS) by Bank for International Settlements. It can be a good measurement of the global financial risk by calculating the financial footprint of nations. We apply this new table to analyze the ripple effects of global financial crisis of 2007–2008 and the European debt crisis of 2011.

## Many a mickle makes a muckle: truncation error in lifecycle assessment

Topic: 814Y LCA and Industrial Ecology (2)
Author: Hauke WARD
Co-Authors: Jan Christoph Minx, Jan Christoph Steckel, Leonie Wenz

Quantifying environmental impacts using process life cycle assessment (PLCA) has become a standard procedure in modern sustainability research. Literature has identified relevant shortcomings in PLCA methodologies influencing results. Some referring to i) the application of cut-off criteria defined by the International Organization of Standardization (ISO) or ii) missing data that influence results lead to truncation errors (TE), which are suggested to be significant, even though the exact size remains debated.
In this paper we first review the literature on TEs and clarify conceptual foundations. We develop a topology of existing approaches that measure and classify TEs in PLCA using Input-Output LCA (IOLCA) and Hybrid LCA. We find that some factors influencing the size of error estimations are insufficiently investigated (e.g. cut-off criteria) or even ignored (e.g. network density, growth rate of flows to be investigated) in the existing literature.
Second, we investigate the identified shortcomings' influence on TEs using and possible limits to TE quantification within IOLCA framework. We design and implement different scenarios to estimate influences on TEs by i) varying thresholding rules in order to comply with ISO norms, i) varying link densities in underlying data and applicants, and iii) neglected service sectors. We implement the scenarios in an IO database for the USA with over 400 sectors investigating embodied CO2 emissions. We find that how to model TEs has a significant influence on their magnitudes, challenging explicit statements made in the existing literature.
Depending on the specifications TEs can be significant in size depending on the scenario: i) neglecting specific sectors can lead to TEs of up 20%; ii) varying thresholding rules can increase existing TE estimates by 10 percentage points on average; iii) the network structure influences the TE significantly and hence needs to modeled explicitly in future estimates.

## How existing technologies can contribute to reducing global CO2 emissions

Topic: 716F Technology and Environment
Author: Hauke WARD
Co-Authors: Armin Fügenschuh, Alexander Radebach, Jan Christoph Steckel, Ingmar Vierhaus

Regional differences of sectoral energy intensities are large, indicating that a convergence of global technology levels towards best practice across the globe holds a huge potential for reducing emissions of global greenhouse gases (GHGs). This paper aims to assess the GHG mitigation potential of converging technological efficiency in terms of CO2-emissions in the industry sectors, building on multiple sectoral input intensities calculated from the World Input-Output Database (WIOD). We develop and apply an innovative analysis framework based on linear optimization of Multi-Regional Input-Output data. Hence, we ensure consistency in supply chains and upstream effects in higher order layers caused by technological changes to be regarded. Neglecting possible rebound effects, we find that even making median sectoral technology accessible in all regional industry sectors across the world could reduce global carbon dioxide emissions significantly, in the order of multiple gigatonnes (Gt). Highest reduction potentials are localized in a small, specific set of sectors consisting of "Coke, Refined Petroleum and Nuclear Fuel", "Chemicals and Chemical Products" and "Basic Metals and Fabricated Metals"

accounting for more than 60% of total reduction. On a regional level, largest reduction potentials can be found in China, India, Russia and the US.

## India’s Renewable Energy target at 2030 : An Integrated CGE and I-O exercise

Topic: 714Y  Special session: Economic and Environmental Impacts of Renewable Energy Targets in Asia
Author: Medhavinee N. WATVE
Co-Authors: Kakali MUKHOPADHYAY

India’s energy demand, which was nearly 700 mtoe in 2010, is expected to cross 1500 mtoe by 2030. Thereby, India’s dependency on imports is expected to increase from 30% to over 50%, suggesting the need for a new way forward. Compounding this problem is widespread energy poverty in India, with almost 22% of the population still without access to electricity. There is an urgent need to explore innovative ways to generate power in a socially, economically, and environmentally sustainable manner.
The renewable energy’s contribution to power generation is still at a fairly nascent stage of ~7% (35GW) as of March 2015. A nationwide campaign has been launched to achieve five times more capacity (175GW) by 2022 and source 40% of installed capacity from renewable energy by 2030 (equivalent to 30% of generation). The government has further enhanced its aspiration by amending the targets from 20GW to 100GW for solar power and 40GW to 60GW for wind power by 2022. Additionally, it has made a commitment of 10GW of biomass and 5GW of small-scale hydro power capacity by 2022.
These ambitious goals and targets are set in light of tripling of projected electricity demand in 2030 from 2012 and rapid urbanization alongside population growth to 1.5 billion in 2030. Moreover, India has voluntarily pledged to the United Nations Framework Convention on Climate Change (UNFCCC) to reduce emission intensity of GDP by 33-35% below 2005 levels in 2030. Providing access to renewable sources of energy will essentially lead to energy security, climate change mitigation, and the achievement of the Millennium Development Goals in the region.
In this backdrop, the current study makes an innovative effort to evaluate the economic and environmental impacts of the targeted Renewable Energy production in India. The study develops an integrated framework including Input-output and Global Computable general equilibrium (CGE) model.
Preliminary results show that an increase in gross domestic product (GDP), industrial output, and employment as a result of the additional production of renewable energy. It also reduces carbon dioxide and other GHG emissions. Further, the advanced knowledge on decentralized renewable, solar and wind, in particular, will bring electric power to millions of Indians who still lack access to electricity today. It will enhance the well-being of the nation.
Further, the result allows us to understand better the risks associated with the implementation of Renewable fuels in the economy. It evaluates the extent to which renewables contribute to the achievement of GHG emission reduction targets compared to traditional fuels.
Input Output Transaction Table published by Central Statistical Organization (CSO 2012), Government of India and the GTAP version 9 will be used to undertake the analysis. The commodities and sectors will be aggregated on the basis of energy intensiveness.

## Industrial agglomeration and regional economic development: the case of China

Topic: 814D Region/country-specific Analysis
Author: Rui WEI
Co-Authors: Wencheng ZHANG

As a developing country with a vast territory, and the implementation of the policy that letting some people and some regions prosper before others since the Reform and Opening-up, China presents different trends of economic development in different regions. Based on China multi-regional input-output tables with 8 regions and 17 industries, this paper analyses industrial agglomeration and its relation with regional economic development. First, we attempt to explore which industry has the feature of geographic concentration by the spatial Gini coefficient. Second, we try to find out inter-regional linkages, namely industry groups between regions by average propagation lengths.

## The spatial distribution of consumption, production and pollution – A different perspective on technology transfer possibilities

Topic: 716F Technology and Environment
Author: Kirsten S. WIEBE

In order to support countries that are interested in exceeding their Intended Nationally Determined Contributions to approach the 1.5°C target, accurate and reliable data regarding greenhouse gas emissions are necessary. How would they find out where in the world their economic behaviour (both consumption and production) has an impact on these emissions? Using the OECD's newly published inter-country input-output table and related consumption-based CO2 emission accounts, we are able to show the different distributions of final goods consumption, value adding activities and CO2 emitting activities around the globe. Using these data, countries can identify their “emission hotspots”, that is partner countries and industries further upstream in the global value chain where a bulk of the CO2 embodied in their final consumption or final goods production are emitted. Using this information, investing countries can better target their technology transfers, which would allow reducing the overall environmental impact of economic activities. The paper uses the example of global demand for motor vehicles to show the spatial distribution of consumption, production and pollution. By examining Germany’s “emission hotspots” abroad, the paper demonstrates the opportunity to transfer technology in a variety of related industries to foster more advantageous environmental outcomes through a reduction in CO2 emitted in upstream production processes around the world.

## The OECD’s approach to disaggregating industries in the inter-country input-output table

Topic: 811W MRIO Modelling and Database
Author: Kirsten S. WIEBE
Co-Authors: Peter Horvát, Norihiko YAMANO

The paper documents the algorithm used to split aggregate industries in the OECD inter-country input-output table (ICIO). The ICIO currently covers 34 industries (in ISIC Rev. 3 classification) in 61 countries and the rest of the world. For some research questions, such as the analysis of

embodied greenhouse gas emissions, material flows or more industry specific analysis, the industry resolution is not detailed enough. Rather than re-estimating the entire ICIO with a higher resolution of data, we are developing an algorithm to split individual industries in a way that the industry totals remain those from the original ICIO. The data used to split the industries ranges from national supply-an-use or input-output tables (the preferred choice) to detailed trade data at the 6-digit HS classification level. In addition, industry specific data (e.g. from the world steel organisation), is taken into account to allow for in-depth industry analysis. The algorithm is for example applied to the “agriculture, hunting, fishing and forestry” industry (ISIC Rev. 3 industries 01T05), the mining industry (ISIC Rev. 3 industries 10T14) and various service industries.

## An Input-Output Virtual Laboratory in practice – Development, uptake, application and impact of the first operational IELab

Topic: 714W  Special session: Input-Output Virtual Laboratories (1)
Author: Thomas O. WIEDMANN

The Industrial Ecology Virtual Laboratory (IELab) is a recently established collaborative cloud-computing platform for compiling large-scale, high-resolution, enviro-socio-economic accounts based on multi-region input-output (MRIO) tables and for conducting integrated sustainability assessment projects for a wide range of topics. IElab has brought together a diverse set of input-output and sustainability researchers and practitioners from around Australia and other countries, enabling tangible, inter-disciplinary research outputs. These include, for example, published triple bottom line assessments of biofuels, low-carbon construction materials or high-resolution waste modelling. This contribution provides a review of past and current IELab applications with a specific focus on the input-output modelling capabilities. The main research question posed is "What are the specific features of IELab that were used in the research and could the research have happened without them?" It is thus investigated whether the IELab has actually and truly enabled new research. The method used is a structured review of research outputs that were published in either peer-reviewed journal papers or in the form of conference proceedings or presentations. An evaluation matrix is presented that lists defined IELab characteristics against possible alternative approaches and the implications of employing those in the research projects. A critical review is also undertaken of the collaborative workflow elements of the IELab, e.g. the writing of data feeds, as well as the actual impacts of the research using the infrastructure. The results of this review can help with the design of new research projects and inform existing and prospective users of the academic research community, public sector agencies and private sector companies and consultancies.

## Global biodiversity impacts of Dutch industries

Topic: 514F  Environmental IO Modelling (1)
Author: Harry C. WILTING
Co-Authors: Mark van Oorschot

Companies have impacts on the global biodiversity loss, for instance by the use of resources and emissions. By influencing their supply chains, individual companies may contribute to avert the biodiversity impacts of their activities. However, the total impacts of companies are not always clear, since supply chains are becoming more fragmented and complex due to increasing globalization and international trade. In order to support companies in taking responsibility for both their direct (company level) and indirect impacts (through their supply chains), we provide

insights in the total biodiversity impact at the level of industries. This supplies information on the average impacts of industries that can be of use as benchmark for individual company calculations.
Where most studies focus on environmental pressures of industries, such as greenhouse gas emissions and land occupation, this paper goes a step further by presenting the combined impact these environmental pressures have on global biodiversity loss, which can be interpreted as a biodiversity footprint by industry. This is done for 48 industries in the Dutch economy in 2007. We quantified the relation between production and global biodiversity loss by using an environmentally-extended multi-regional input-output (MRIO) model based on data from the WIOD and GTAP databases including international trade flows. The MRIO model was used to trace the supply-chain contributions of industries in regions all over the world in terms of several biodiversity relevant environmental pressures. By extending the environmental pressures with spatial information and cause-effect relationships obtained from the GLOBIO biodiversity model, we calculated the impacts of these environmental drivers on terrestrial biodiversity. Mean Species Abundance (MSA) was used as a biodiversity indicator which is a representation of the degree of ecosystem naturalness. The MSA indicator is calculated by comparing the mean abundance of occurring species in a disturbed situation relative to their abundance in undisturbed ecosystems.
For most industries in the Dutch economy, more than 50% of the supply-chain biodiversity losses took place in other countries. The supply-chain biodiversity impacts of the food industry, which showed the highest biodiversity footprint, were for more than 90% abroad. The losses were mainly caused by land occupation for agriculture and related spatial pressures, such as fragmentation and infrastructure. The electricity and gas industry, which was second in terms of biodiversity footprint, showed a large impact on biodiversity mainly caused by greenhouse gas emissions. Primary resource producing industries, such as cattle farming, forestry and arable farming, showed the highest biodiversity footprint per euro turnover.

## Decoupling consumption from our environmental pressures and impacts - a global Multi-Regional analysis with EXIOBASE

Topic: 514Z  Special session: Compilation and Application of EXIOBASE 3 – a time series of highly detailed EE MRIOs
Author: Richard WOOD
Co-Authors: Konstantin STADLER, Arnold Tukker

If society wants to keep growing, it must decouple from environmental impact. Many developed countries are seeing this decoupling in terms of the environmental impact on/from their domestic territory. When looked from a consumption perspective, however, work on greenhouse gas and material footprints show an apparent lack of decoupling. We look into the rate of the decoupling from both a production and consumption perspective, and look beyond emissions and materials into multiple pressure indicators, and translate that to impact indicators where possible. We argue that ultimately it is lifestyles and well-being of the population that we want to improve, and that this is most closely linked to consumption based approaches.
We utilise the results from the EU fp-7 project DESIRE project, which seeks to investigate the development of resource efficiency indicators over time. In doing this, DESIRE adds a temporal dimension to previous multi-regional input-output (MRIO) work within the EXIOBASE database. We model technical change in the underlying supply use system based on exogenous growth of the economy from National Account data, and by using balancing techniques to incorporate and reconcile data sources. The analysis presents the first results from the DESIRE project in terms of EXIOBASE v3, and we anticipate this database to be finalised and publicly available in early 2016.

Using a MRIO model allows us to explicitly analyse different drivers of impact over time. We focus on six drivers – end-of-pipe technology; other technology; the role of trade; the role of the consumer; population and affluence. As such, we can explicitly compare the role that globalisation has had on rates of decoupling – has the opportunity to trade with resource rich countries reduced our rates of decoupling or increased?
We find that decoupling of land and water based pressures has had a much lower rate than greenhouse gas and material based decoupling. It can be seen that efforts to contain greenhouse gas emissions are flowing through the consumption based emissions indicators, but not those indicators unlinked from energy use.

## Swedish Footprints: Policy-Relevant Indicators for Consumption and Environment

Topic: 714F  Environmental IO Modelling (3)
Author: Richard WOOD
Co-Authors: Viveka Palm

This presentation introduces the input-output relevant work of PRINCE (Policy-Relevant Indicators for Consumption and Environment). PRINCE is a multi-partner, cross-disciplinary project aiming to develop a sound and repeatable methodology to monitor the environmental impacts of Swedish consumption, both inside and outside Sweden's borders.

Sweden has set itself the ambitious goal of handing over to the next generation “a society in which the major environmental problems in Sweden have been solved”. Significantly, this is to be achieved “without increasing environmental and health problems outside Sweden’s borders”. This so-called Generational Goal constitutes the overarching goal of current Swedish environmental policy. Yet measuring the diverse environmental impacts of a country's consumption, particularly beyond its borders, is extremely challenging. These impacts may be spread along a myriad of long, complex and very fluid global supply chains.

PRINCE responds to a call from the Swedish Environmental Protection Agency (Naturvårdsverket) for a pioneering monitoring framework for its consumption-based accounting, based on the latest modelling and statistical techniques. The framework will cover a uniquely broad range of environmental pressures, including: Emissions of greenhouse gases and traditional air pollutants (SO2, NOx, NH3, VOCs) from fossil fuel burning, manufacturing processes, livestock production and land-use change Impacts of the consumption of resources such as water and land. Exploratory indicators for use or emission of hazardous chemical substances.

PRINCE will develop an economic-environmental monitoring framework based on multi-regional input-output (MRIO) analysis. The research will have four main strands and outputs: Evaluation of existing consumption-based accounting models and calculations, to identify those most appropriate to integrate with Swedish national accounting data. Identification and quantification of a range of environmental pressures from Swedish consumption. Identification of those product groups with the largest environmental impacts, and where those impacts take place. Development of a sound, repeatable methodology for monitoring, in line with official statistical criteria.

This presentation covers the overall goals and first results of the project. It concentrates on methods used to operationalise the accounts - especially the link between the MRIO models, and

the available Swedish IO tables.

## Emissions trading in China: a partial transmission and indirect emissions input-output analysis

Topic: 516Y  Energy IO Modelling (2)
Author: Yan XIA

To achieve a 40–45% goal for reduction of carbon intensity, China cannot continue to rely only on costly administrative measures, it must also increasingly turn to market-based methods. In 2013, China established seven pilot markets for carbon-emissions trading under the 12th Five-year Plan (12th FYP, 2011–2015) to find a way toward a unified national carbon-trading market. The reduction targets at the provincial level over the period 2010 to 2015 ranged from 17 to 21%. Because carbon markets have been advocated as the most promising, efficient and effective policy instrument to avoid serious climate change, scholars from various countries have been studying the methods and likely results of carbon trading. There have been several studies that analyzed carbon emissions markets at the macro level. Some of these have provided overviews of the market coalition and the accounting method used in emissions trading, while others investigated the economic impact of emissions trading, especially in terms of  cost-effectiveness and permit pricing (Zhou et al, 2013; Cui et al.2014; Wu et al.,2015; Fan et al,2016; Zhang et al, 2014; Jotzo and Löschel,2014). These studies can also be divided into those that have focused on estimating the impacts of emissions trading at the national or regional level (especially for the pilot markets), and those that have focused at the industrial sector level(electricity, building, transportation, etc.).
One hand, emissions embodied in trade are therefore important for defining the regional CO2 emissions reduction and its exogenous ceiling. Production-based accounting (PBA) can represent all emissions generated by the production activities of a country or other entity. Consumption-based accounting (CBA) allocates all emissions created along the chains of production and distribution. On the other hand, emissions embodied in production chains are also important for defining the industrial CO2 emissions reduction. Greenhouse gas emissions are categorised into three scopes by the most widely-used international accounting tool, the GHG Protocol. While scope 1 and 2 cover direct emissions source (are emissions from sources that are owned or controlled by the reporting entity), scope 3 emissions cover all indirect emissions (are emissions that are a consequence of the activities of the reporting entity, but occur at sources owned or controlled by another entity) due to the activities of an organization.
Despite the number of studies focused on emissions accounting methods, it is still unclear how different accounting methods have contributed to the stickiness of China's price pass-through. In particular, how and to what extent does China's price control policy affect its price index and economic development under national emissions trading market? To address these questions, we will develop a partial transmission input output model that captures the uniqueness of the Chinese carbon trading market. In traditional input output model, the price turbulence in upstream industries can be completely and instantaneously transmitted to downstream. However, price control policy on certain commodities are still implemented in China today, suggesting the need to modify the traditional IO model to better reflect the real economy and derive the realistic results. We will incorporate the stickiness in China's price transmission mechanism into the traditional IO model, thus better simulate the price pass-through. We will apply an interregional input-output model to derive cost curves for regional marginal abatement and estimate interregional embodied emissions and indirect emissions. It then proposed an emissions trading model for exploring the impacts of emissions accounting methods on trading markets in the context of China achieving its 12th FYP intensity reduction target. The estimation

of carbon emissions is one of the key determinants of the total cost due to emissions trading and permits price, which affect the design of the national carbon trading scheme.

## A Review Assessment of Health and Economic Impacts of Global Heat Waves

Topic: 809F  Environmental IO Modelling (4)
Author: Yang XIA

Anthropogenic climate change has caused an increasing number of extreme weather events, such as flood, hurricane and heat waves. Compared with flood resulting in huge capital damages, capital damages by long-term environmental stress including heat waves can be negligible while the negative impacts on human beings can be substantial. Heat waves in Europe during 2003 caused over 15,000 deaths, highlighting the significance of disaster risk studies on heat waves and more comprehensive understanding of heat effects on labor and entire economic systems. However, existing heat wave studies mostly focus on the relationship of either heat-health or heat-productivity but few can be found to integrate heat exposure, health effects and productivity loss into economic impact evaluation. Even so, measurements are generally based on individuals' compensations at microeconomic level. We suggest such method is insufficient to reflect the impacts on national economy because the important interrelationships among sectors are neglected. By reviewing substantial heat wave studies, our paper provides a comprehensive view over heat effects on human beings, including both physiological (mortality and morbidity mainly due to respiratory and cardiovascular diseases) and sub-clinical effects (absenteeism: reduced work capacity and presenteeism: work productivity loss). Also, by viewing labor as factor input in production process, the paper also propose a way to feed these effects back into economic impact assessment via which sector interrelationships can be captured. Finally, we emphasize the importance in: 1) Sub-clinical effects can be analogous with physiological effects and they can cause the disruptions for economic activities; 2) Differentiating work capacity loss from productivity loss; 3) Integrating health or impact assessment studies into disaster risk analysis. These can be crucial for the public, healthcare sector and policymakers in understanding heat waves, providing protective infrastructure and developing better climate adaptation strategies.

## A global MRIO Lab – overview of concepts and architecture

Topic: 714W  Special session: Input-Output Virtual Laboratories (1)
Author: Yanyan XIAO
Co-Authors: Arne GESCHKE, Muhammad Daaniyall ABD RAHMAN, Keiichiro Kanemoto, Manfred LENZEN

We describe the creation of the Global Multi-Region Input-Output (MRIO) Lab, which is a cloud-computing platform offering a collaborative research environment through which participants can use each other's resources to assemble their own individual MRIO versions. The Global MRIO Lab's main purpose is to harness and focus previously disparate resources aimed at compiling large-scale MRIO databases that provide comprehensive representations of interregional trade, economic structure, industrial interdependence, as well as environmental and social impact. Based on the operational Australian Industrial Ecology Lab, a particularly important feature of this cloud environment is a highly detailed regional and sectoral taxonomy called the "root classification". The function of this root is to serve as a feedstock from which researchers can choose any combination of regions and economic sectors to form a model of the economy

that is suitable to address their particular research questions. Thus, the Global MRIO Lab concept enables enhanced flexibility in MRIO database construction whilst at the same time saving resources and avoiding duplication, by sharing time- and labour-intensive tasks amongst multiple research teams. We explain the concept, architecture, development, and preliminary results of the Global MRIO Lab, and discuss its ability to continuously deliver some of the most prominent world MRIO databases such as EXIOBASE, WIOD, and Eora.

## Development and Challenge of the Japan-Korea-China International Input-Output Table

Topic: 714A  Special session: Competitive and Complementary Economic Relationships between Korea and Japan
Author: Mitsuo YAMADA
Co-Authors: Zaizhe Wang, Kozo Miyagawa

The globalization of the economies has strengthened the interdependence among countries in the world. This interdependence can be analyzed by using the international IO tables. IDE-JETRO and the METI in Japan have leaded in this field so long time. In recent years, the international IO tables have obtained the increasingly growing interests, from the view point of the value-added trade and the value chain. The development of The WIOD / OECD IO databases is well known. Yokohama National University, Global IO database in Japan has also been recently open to public.
The WIOD and YNU-GIO databases intended to cover relatively wide areas including more than 30 countries, though the sector classification is not so detailed. On the other hand, METI tried to build bilateral IO tables; 2000/2005 Japan-US table and 2007 Japan-China table. The Japan-US tables have adopted relatively detailed sector classification with more than 170 sectors, though the Japan-China table has 77 sectors. The Asian IO of IDE has moderate size in regions, 10 regions, with relatively large size of sectors, 76 sectors.
We are conducting to construct the 2012 international IO table of Japan, Korea, and China to analyze their interdependence, which is highly increasing through the direct investment and the international commodity trade. After reviewing the recent experiences of the international IO databases, we discuss about the framework of our IO table, the characteristics of sector classification, the advantage and disadvantage of it comparing with the other international IO tables, and what analyses are able to be expected.

## Divergent and Convergent Evolutions of Jobs and Value Added Contents in International Trade

Topic: 711E  Special session: SIC-OECD-IDE/JETRO Joint special sessions on Development, Employment and Inequality (1)
Author: Norihiko YAMANO
Co-Authors: Peter Horvát

Using the recently extended databases of OECD Inter-Country Input-Output Table (2015ed) and harmonized sectoral jobs data, this paper presents the challenges of database development and analyses the annual evolutions of foreign contents in international trade for 60+ economies from the mid-1990s to the recent years. Significant differences in trends on foreign contents in domestic demand and gross exports are identified for different country and industry groups. In addition to value-added contents, recently estimated employment and income shares (labour compensation) for target economies also show the divergent and convergent evolutions in the

roles of countries in global production networks (GPNs).

## Economic Impact Analysis of Natural Disasters: CGE Modeling Approach

Topic: 814B  Special session: Disaster Impact Analysis
Author: Masato YAMAZAKI
Co-Authors: Atsushi KOIKE, Yoshinori SONE, Hirokazu Tatano

As economic losses from natural disasters increase, assessing the economic impact of a future possible natural disaster is becoming increasingly important. A computable general equilibrium (CGE) model is a strong candidate as an impact assessment model. However, critics of CGE models state that key parameters are often not estimated econometrically. The purpose of this study is to calibrate a set of substitution parameters in a CGE model for the economic impact assessment of a natural disaster. We develop a recursive-dynamic multi-regional CGE model for Japan, and then calibrate a set of substitution parameters for the model. For the calibration, we employ a heuristic method in which the substitution parameters are adjusted to reproduce the actual economic impacts of the 2011 Great East Japan earthquake. Although this was a one-off event, the magnitude of its impact on the Japanese economy was large enough to distinguish it from other events.
The validity of the calibrated parameters is confirmed by reproducing the economic impacts of the Great East Japan earthquake in the CGE model. Statistically, the reproducibility of the simulation results is assured for the shock to industrial production in the first month after the earthquake. The dynamics of industrial production in the CGE model reproduce the actual path of industrial production well, excluding a region where there are many automaker assembly lines. This reveal two facts. The value of the substitution parameter affects the restoration path of industrial production, as well as the short-term impacts. However, the reproducibility also depends on the market clearing condition in the CGE model. The market clearing condition ensures that supply instantly equals demand in markets for goods and primary factors. On the other hand, the observed data reveal that inventory could delay the propagation of negative shocks, such as supply chain disruptions in the automotive industry.

## Emissions in exports versus emissions replaced by imports: testing the testing of hypotheses

Topic: 814F  Trade and Environment
Author: Bingqian YAN
Co-Authors: Erik DIETZENBACHER

Understanding what determines the trade in emissions is important for the global negotiations about allocating responsibilities. In the first part of this study we test two competing hypotheses, the Pollution Haven Hypothesis (PHH) and the Factor Endowment Hypothesis (FEH). Each hypothesis yields a ranking of countries (based on GDP per capita for the PHH and on the capital/labor ratio for the FEH) and provides a prediction for the comparison of the emissions in average exports and the emissions replaced by average imports. The tests are carried out for any pair of two out of 40 countries (i.e. 1560 pairs of countries). For this, the extra CO2 emissions in a country due to an increase of 1 billion USD of extra exports are compared with the reduction in this country’s CO2 emissions due to 1 billion USD of extra imports. We find that neither the PHH nor the FEH is widely supported by the empirical results. The PHH yields correct predictions in

31.7% of all cases and the FEH yields correct predictions in 36.7% of all cases.
In the second part of the paper, we examine whether any hypothesis that bases its predictions on the ordering of countries can be sufficiently corroborated. We find that the optimal ordering of countries (obtained by applying triangularization techniques) yields correct predictions in only 60.1% of all cases. The outcome is robust to changes in the underlying assumptions. We conclude that a successful prediction for the comparison of the emissions in exports and the emissions replaced by imports cannot be based on a ranking of countries (such as the size of GDP per capita or relative capital abundance).

## Compiling SUTs with firm heterogeneity: methods and challenges for the case of China

Topic: 716W  Special session: APEC TiVA: SUTs with Firm Heterogeneity (2)
Author: Cuihong YANG
Co-Authors: 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. However, as to 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.

## Applying Multi-Regional Input-Output Analysis to Evaluate the Impact of Indirect Energy Consumption on Energy Security

Topic: 514Y  Energy IO Modelling (1)
Author: Hao-chuan YANG
Co-Authors: An-yi CHIN

There has been increasing attention being paid to the issue of energy security in recent years. In order to access the energy security situation, many indicators are developed toward to a more complex and multi-dimensional way. However, most indicators involved energy consumption ignores the indirect effect from international trade. Consequently, this paper intends to assess major Eastern Asia countries energy security by combining the Multi-Regional Input-Output analysis and energy security indicator system to consider the indirect energy consumption effect based on the World Input-Output Database. The result shows that the foreign energy embodied in traded goods could affect energy security and serves as an important insight for the government agency in charge of relevant energy policy.

## The drivers of China’s regional carbon emission change -a structural decomposition analysis from 1997 to 2007

Topic: 516E  Enviromental Analysis for Development (2)
Author: Ling YANG

Using the three newly published multiregional input-output tables and carbon emission data, we decompose change in carbon emission for eight regions of China between 1997 and 2007 into following partial effects- changes in energy end-use structure, effect of energy efficiency, value-added’s share of gross output, changes in sub-industry structure, changes in import substitution of intermediate input, changed final demand structure and level. We found energy efficiency contributed most of CO2 abatement throughout China while other factors varied greatly in different regions. We suggested government should consider regional disparity and CO2 flow when formulating policies; energy structure change and efficiency improvement such as energy-saving buildings would also be effective measures.

## An analysis on Relation between Consumption Based Emissions and Tax

Topic: 514F  Environmental IO Modelling (1)
Author: Yoo-kyung YANG
Co-Authors: Jong-soo LIM, Yong Gun Kim

1)  The Research Question
This analysis study starts from the a question that “’is a national tax system dependent on CO2 emissions?” ‘, and “’have there any relationship betweendoes  consumption based CO2 emissions correlate to and taxes?’. We implement a correlation analysis between CO2 and tax embodied in consumption. Also Additionally, we considered take into account that the implicit carbon price, which is the total CO2 emissions (included including CO2 embodied in consumption) , that effect on the total tax. Then we estimate effect of implicit carbon price on GDP per emission.
2)  The method used
We use both Multi-Regional Input-Output (MRIO) analysis and Single-Regional Input-Output (SRIO) approaches. SRIO assumes a closed economy, so it covers only domestic supply chain. However, MRIOA enumerates global supply chain and thus only consider imports to final consumers with trade in intermediate consumption calculated endogenously (Peters et al., 2011).
The estimation of consumption based CO2 emission consists of multiplying a diagonal matrix of CO2 emissions coefficient to Leontief inverse matrix and diagonal matrix of final demand. Leontief inverse matrix represents the supply chain. Calculation of consumption-based tax uses the different tax input data depending on our choice of SRIO or MRIO. The SRIO approach uses production taxes and domestic intermediate goods taxes in order to calculate the diagonal matrix of tax coefficient. However, in the MRIO approach, the diagonal matrix of tax coefficient is derived from production tax, domestic intermediate goods tax, import intermediate goods tax, export tax, and import tariff data. Similarly, the consumption-based tax is calculated by multiplying tax coefficient diagonal matrix to Leontief inverse matrix and final demand diagonal matrix (or final demand matrix).
Using SRIO and MRIO methods, we obtain the consumption-based CO2 emission and taxes. Then, we can build regional linear regression equation having total emissions (including consumption based emission) as an independent variable and total tax (including consumption based tax) as a dependent variable. The estimates of regional independent parameter is obtained through regression analysis is considered the implicit carbon price. In addition, we draw a scatter plot that

put regional implicit carbon price on the x-axis and GDP per emission on the y-axis. Also we can set the global regression equation having implicit carbon price as the independent variable and GDP per emission as the dependent variable.
3) the data used
We use the GTAP (Global Trade Analysis Project) 9.0 database, which has 140 regions and 57 commodities. GTAP provides data of benchmark years of 2004, 2007 and 2011 data. In this study we utilize 2011 data for SRIO analysis. In addition, for the MRIO analysis, we considered the data of 2004, 2007 and 2011. We constructed the global input output table for MRIO analysis. This table is handling the international transport endogenously. The international transport matrix using international trade for intermediate commodities add intermediate input-output matrix and the international transport matrix using international trade for final goods add final demand matrix.
4) Results
Results of regional regression obtained from the SRIO analysis show the lower implicit carbon price in the case of low GDP per emission countries (China, Russia, Iran, South Africa, India and South Korea) than other countries. However, high GDP per emission was shown in the countries such as Japan and EU countries. These countries present higher implicit carbon price as well. Also, the result of global regression shows that one unit increase of implicit carbon price induces increase of GDP per emission by 0.7567. In the meantime, results of global regression analysis using the MRIO method illustrate that an increase of one unit of implicit carbon price increments GDP per emission as well. But, the relationship becomes weak year-by-year; the result was 1.5752 in 2004, 1.3262 in 2007, 1.1423 in 2011.
Comparing implicit carbon prices resulting in SRIO and MRIO approaches, implicit carbon price using the MRIO method is lower than the result obtained by the SRIO approach. In particular, the gap between the two implicit carbon prices is bigger on Japan and EU countries. The reason for this gap is that MRIO analysis reflects the effect of international trade. Therefore, we conclude that carbon pricing effect is diminished by international trade.
5) Novelty of the research
In this study, the implicit carbon price has different definition than the other studies. It is determined as total emissions impact on the total amount of tax to the implicit carbon price while the other studies estimate the implicit carbon price based on financial incentives for greenhouse gas reduction.

## A Local-Currency-Based Multi-Sectoral Model for Global Economic Analysis: The Data and Structure

Topic: 811W  MRIO Modelling and Database
Author: Takashi YANO
Co-Authors: Tsubasa Shibata

Economic agents make their decisions by focusing on the economic performance of their economies in their currencies rather than in a foreign currency. This shows that a multi-country economic model in local currencies is suitable to analyze global economic issues. However, international input-output tables are denominated in a specific currency such as the US dollar. Employing the OECD Intercountry Input-Output Tables, this paper presents a method to convert the international input-output tables in US dollars and current prices to those in local currencies and constant prices. In addition, this paper illustrates the structure of a global model which is based on the resultant tables.

## Impact of Railroad Investments on Regional Economies: an Approach of Spatial CGE Model with a Microsimulation Module of Railroad and Highway Networks

Topic: 716C Special session: Development of CGE Models for Transportation Policies
Author: Yoojin Yi
Co-Authors: Euijune KIM

This paper develops a framework for economic analysis of high-spped railroad of Korea (KTX) in order to estimate the dynamic economic effects of transportation project on the economic growth and the regional disparity in Korea. The framework is composed of a Spatial Computable General Equilibrium (SCGE) model and a microsimulation module or transport model of highway and railroad networks. The latter module measures a change in interregional accessibility by highway and railroad line, while the SCGE model estimates the spatial economic effects of the transportation projects on the GDP and the regional distribution of wages. The simulation allows policy makers to determine which transportation development deserves the priority for investment based on consideration of economic growth and regional economic equity in the long run. The simulation found that overall impacts of the railroad projects are positive on indirect economic benefits of regional economies, but they could have competitive relations with the highway projects.

## Characterizing Global and Regional Value Chains

Topic: 514W Special session: Global Production Networks: Theory and Empirics (1)
Author: Xinding YU
Co-Authors: Zhi Wang, Shang-jin WEI, Kunfu ZHU

Since the extent of offshoring and production sharing varies by sector and country, we develop measures of GVCs in terms of length, intensity, and location of participation at the levels of country, country-sector, and bilateral sector, and distinguish among pure domestic, directly traded, and indirectly traded production activities. Using these measures, we characterize cross-country production sharing patterns and GVC related trade activities for 35 sectors and 40 countries over 17 years. We find that the production chain for the world as a whole has become longer. While the relative ranking of the length at the sector level is stable across countries, the average length for a given country-sector, of both the domestic and international components, and their participation and position in GVCs in general, do evolve significantly over time. The results contribute to a better understanding of features of global value chains and patterns of participation by individual country-sectors.

## Comparative Study of Economic Structural Change and Growth Impetus —Based on 2007 and 2012 China input-output table

Topic: 811E Special session: SIC-OECD-IDE/JETRO Joint special sessions on Development, Employment and Inequality (4)
Author: Jianqin YUAN
Co-Authors: Yaxiong ZHANG

Abstracts:Over the past 20 years, structural decomposition analysis(SDA) become one of the important tools to research economic structural adjustment and growth impetus at home and

abroad. The Thirteenth Five-Year Plan period is the key time to the depth of China's structural change, what is the trend and path of the economic structure adjustment during the period is a major problem. Therefore, at first this paper intend to analyze comparatively the characteristics of the production and consumption structure between 2007 and 2012 from the perspective of industry associations, then, base on structure decomposition analysis (SDA), break down the source of economic growth. Firstly, decompose the economic growth into three factors: value-added rate, technological progress and final demand change, and further, the final demand change will be decomposed into the final demand level, distribution and the way of change. Finally, propose the motivation and direction of industrial structure adjustment, so as to transform the motivation of China economic growth and upgrade industrial structure.

## Research on the Intermediate Consumption of Manufacturing Industry during Inserting into the Global Value Chain in Yangtze River Delta Area of China

Topic: 811X IO Analysis for Policy-making (2)
Author: Xiaohui YUAN
Co-Authors: yan ling HUA, Jin FAN

As an important carrier of China's regional economy, the manufacturing industry of Yangtze River Delta region has highly concentrated development effect than other regions. The gross industrial output value of Jiangsu, Zhejiang and Shanghai in 2014 reached 5.84 trillion yuan, which was higher than the Pearl River Delta and the Bohai Rim. Among them, Jiangsu's gross industrial output value was as high as 3.11 trillion yuan，accounting for more than half of the Yangtze River Delta region, and got the second place of the country. At the same time, with the advance of globalization, the ratio of import and export trade of goods to GDP of Yangtze River Delta region continued to rise, and the number attached to 66% in 2014. Intermediate inputs occupy an increasingly large share in the import and export trade, and this foreign-oriented economy mode promotes the development of Yangtze River Delta region.

However, in background of the current economic new normal, Yangtze River Delta region is also facing many serious challenges. Although the "Belt and Road" and the "Yangtze River Economic Belt" has brought new opportunities for development to Yangtze River Delta Region, however, more manufacturing enterprises are international OEM makers and are locked in the low-end path with low added value in a long time, since it is mainly depended on its abundance of low technical level labor and natural resources, to participate in international intra product specialization of the high technology industry in the early stages of inserting into global value chain, and therefore it is hard to overcome as a result of being locked in the low-end links such as assembly process. So under the current economic new normal environment, manufacturing enterprises in Yangtze River Delta Region need to get rid of the low-end locking in developed countries in the global value chain, and improve the added value, which means they must reduce the intermediate consumption in the productive process to increase economic efficiency. Intermediate input is also a kind of capital, with an important role in the production process, which can't be ignored. The level of it reflects the quality and efficiency of economic growth in fact.

So taking input-output tables in 1997, 2002, 2005, 2007 and 2010 of Jiangsu, Zhejiang and Shanghai as the basic data source, and based on the measurement of the degree of inserting into the global value chain of manufacturing industry in Yangtze River Delta region, this paper has a further study on Jiangsu manufacturing industry as an example, analyzes the dynamic evolution characteristics of the intermediate consumption of different manufacturing industries during inserting into the global value chain, and then seek explanations from the perspective of technological progress and structural changes. The research shows that: Firstly, with respect to

Zhejiang and Shanghai, the degree of inserting into the global value chain of Jiangsu manufacturing industry is higher. The industries with the higher proportion of the total output value of manufacturing industry, such as communications equipment, computers and other electronic equipment manufacturing industry, chemical industry, metal smelting and rolling processing industry and textile industry, have higher degree of inserting into the global value chain; Secondly, the industries with higher degree of inserting into the global value chain also have higher intermediate consumption; Thirdly, although the technological progress reduces the intermediate consumption of the industries with the higher degree of inserting into the global value chain, the industrial structure upgrading enhances the nature of the intermediate products of these sectors.

## Pakistan’s Entry into the Proposed Regional Comprehensive Economic Partnership (RCEP) - A CGE Approach

Topic: 516X  Regional Trade Agreement and Trade Governance
Author: Naseeb ZADA
Co-Authors: Muhammad Aamir KHAN, Kakali MUKHOPADHYAY

Given the importance of international trade in economic development, this study evaluates the potential impacts of Pakistan’s proposed entry into the ‘Regional Comprehensive Economic Partnership’ (RCEP) using the global Computable General Equilibrium (CGE) model. Pakistan is not part of the proposed RCEP as it has not been invited to join this partnership. Pakistan has no FTA with ASEAN and so its trade with ASEAN is not too much significant. However, Pakistan has good trade relations with Japan, China, Korea, Malaysia and India and all of the 6 economies other than the ASEAN are direct or indirect competitors of Pakistan’s exports and imports. This proposed agreement will however, facilitate trade among the member economies and so will adversely affect Pakistan’s trade with its existing partner economies due to the trade diversion if Pakistan is left out of this regional block.
It is pertinent to mention that the share of RCEP countries in total exports of Pakistan is 22 percent and its share in total imports of Pakistan is 42 percent. Pakistan has also signed bilateral trade agreements with China, Malaysia and Indonesia and having intra-industry and strong product complementarities with these economies. All this means that Pakistan has significant complementarities with ASEAN + 6 and so its entry into the proposed RCEP will significantly reduce the trade costs of its potential trading partners in the region and will yield region-wide gains. Pakistan’s entry into RCEP is also significant for the ASEAN region as it can reduce the distant to the Central Asian economies which is one of the main exports destined regions of RCEP exports. The recent example is the Pak-China economic corridor that will potentially reduce the regional trade costs and so its entry into the RCEP is expected to reduce the trade costs in the region. However, if Pakistan is left out of this regional partnership, Pakistan will lose market of both imports and exports in the region. This will yield high loss to Pakistan in terms of trade diversion. However, the government of Pakistan is effectively working on this issue and attempting to its level best to become part of this regional association as RCEP is open for other economies, although Pakistan has not been invited to join the RCEP.

Given this new backdrop we analyzed the potential impact of the Pakistan’s entry into proposed RCEP agreement. A newly developed framework, MyGTAP (Minor and Walmsley, 2013), is used to incorporate more detailed information on Pakistan’s labor and household groups into the GTAP database by using the latest available comprehensive Social Accounting Matrix (SAM) 2007-08. It allows more flexibility in the treatment of government savings and spending by removing the regional household of the standard GTAP model and replacing it with a separate government and

multiple private households. The model also includes transfers between government and households and among household groups, remittances and foreign capital incomes, thus allowing assessment of policy impacts on different household groups and production factors within an economy of interest.

The study attempts two simulation exercises. The first one includes Current RCEP with business as usual implementation of proposed RCEP with full trade liberalization among the RCEP countries. The second simulation investigates the inclusion of Pakistan in the proposed RCEP.

Results obtained are sufficiently different across the two experiments associated with two alternative forms of RCEP, particularly for Pakistan. The impact of RCEP on real GDP of Pakistan is negative under the first experiment and positive under the second experiment. However, the impact on real GDP of other RCEP member economies is positive under both the simulations with a higher increase under the second experiment as compared to the first simulation. It indicates that Pakistan's entry into RCEP is expected to yield region-wide gains. On the other hand, the impact of RCEP on real exports and imports of Pakistan is positive which reflects that Pakistan's proposed participation with RCEP will boost up regional trade flows and so region-wide gains. Pakistan's entry into RCEP is also significant for the ASEAN region as it can reduce the distance to the Central Asian economies which is one of the main exports destined regions of RCEP exports. The recent example is the Pak-China economic corridor. It will potentially reduce the regional trade costs and so its entry into the RCEP is expected to reduce the trade costs in the region. This study suggests Government policy makers to negotiate Pakistan's entry into the RCEP group with the member economies.

## Food Choices, Health and Environment: Effects of the Dynamics of Chinese Diet

Topic: 814C Special session:Economic Impacts of Specific Foods: Kimchi, Tsukemono, Tomato
Author: Haiyan Zhang
Co-Authors: Michael L LAHR

China's food consumption patterns had changed dramatically during the past three decades. Chinese diets have shifted towards an unhealthy Western type, which characterized by high intake of meats, oil, refined fats and refined sugars. Diets link environmental and human health. Diet changes associated livestock production requires large areas of land and lead to high nitrogen and greenhouse gas emission levels. The 2010 Global Disease Burden shows that the composition of Dietary risk factors is the top contributor to disability-adjust-life-years and deaths in China. Since its great environmental and public health importance, the tightly linked diet-environment-health trilemma is a global challenge and opportunity, especially for China. By using a hybrid Economic input-output and lifecycle assessment (EIO-LCA) model, we examine the carbon footprint and nutrition transition of China's food consumption from 1992 to 2012. Based on scenario analysis, we also predict the large-scale health and environmental consequence in China by replacing current food consumption pattern by alternative diets. This study would yield some valuable suggestions for both policy makers and consumers on the implementation of dietary solutions and green consumption.

## What matters in measuring domestic value added in exports by international or single country model

Topic: 809E  Special session: SIC-OECD-IDE/JETRO Joint special sessions on Development, Employment and Inequality (3)
Author: Hongxia ZHANG
Co-Authors: Geoffrey J.D. HEWINGS

This paper proposes a method to compute the domestic value added in exports based on international input-output model, and examines it with the method based on single-country model using world input-output table. It shows that for any country, in total, the results of domestic value added in exports by international IO model equal to that by single country IO model. However, in decomposition, the method on international IO model gives the effects of feedbacks among countries, originating from the inter country division and the international industrial chains. Yet the results of single country model cannot provide this kind of decomposition. Then by using WIOTs, we compute the domestic value added in exports by the method in this paper, and analyze the results.

## Analysis of CO2 emissions embodied in the urban water use in China

Topic: 714E  Special session: Economic and Environmental Relationship in Asian-Pacific (1)
Author: Qian ZHANG
Co-Authors: Yuichi MORIGUCHI, Jun NAKATANI

Drinking water supply and wastewater treatment require significant energy input, and now reduction of GHG emissions from the water sector becomes one of important climate mitigation strategies for the municipalities. The aim of this paper is to examine both direct and indirect CO2 emissions embodied in the urban water use (including water supply and wastewater treatment services) for China. We compiled a 135-sector embodied CO2 inventory in terms of (I-(I-M)A)-1, which impacts from import were excluded. Data sources are mainly from 2007 Chinese Input-Output Tables, Chinese national energy statistics, and IPCC guidelines for GHG accounting. One progress is our careful disaggregation process to allocate energy consumption into each IO sector. The accounting boundary of indirect GHG emissions from process-based approach (like WRI Scope 3 standard) is usually different from the IO-based estimation. Therefore, another highlight lies in our proposed attribution way of embodied CO2 emissions to make it comparable with these process-based LCA estimations. The results show that CO2 emissions from urban water use can be double if upstream induced emissions are taken into account, which are mainly from indirect requirement for electricity, metal products, water conservation service, basic and special chemicals, plastic and so on. This implies that efficient energy uses as well as good maintenances of urban water systems are main potentials for CO2 emission reduction in the water sector.

# Making ‘dirty money’ out of exports: Estimating value-added and pollution exports in China

Topic: 514E  Enviromental Analysis for Development (1)
Author: Wencheng ZHANG
Co-Authors: Rui WEI

As the world’s largest exporting country, China is also one of the largest air pollutant emissions emitters in the world. Exports contribute both to income creation and environmental degradation in China. However, rare studies explore both of them in a consistent framework. In the present paper, we analyzed simultaneously the economic benefit and environmental burden of exports in China using a global input-output model based on World Input-Output Database (WIOD). We compare China’s environmental burdens of exports with those of the other major economies in multiple aspects. Particularly, we analyze the environmental efficiency gaps between China and the other countries using structural decomposition technique. In this paper, the economic benefit is measured by the value-added exports which are income (wage and capital return) created in the export production, while the environmental burden is measured by the emissions exports of 8 types of air pollutants which are generated by China’s export production.

The results show that value-added exports in China increased significantly during 1995-2009. The share of value-added exports in Chinese GDP increased from 16.8% to 32.3% in this period, indicating that exports are of great importance for the income creation in China. Meanwhile, remarkable emissions were generated by export production in China. Emissions exports of CO2 and NOX increased by 232% and 211%, respectively, during 1995-2009. For the other pollutants, emissions exports also increased by over 100%. Shares of emissions exports in total emissions from production of China also rose up greatly. In 2009, emissions exports accounted 22%~35% of total emissions from production in China.

By the comparison across countries, we find that China’s share of value-added exports in the global value-added trade reached 10.4% in 2007 which was the second largest in the world. However, the global share of emissions exports of China was significantly greater than that of the other countries and much greater than the share of value-added exports for most types of pollutants. While the emission intensities of exports (PIE, ratio of emissions exports to value-added exports) in China were continuously declining for all pollutants in study period, they were still significantly greater than those of developed countries and of some developing countries.

We use structural decomposition technique to analyze the factors determining the PIE gaps between China and selected countries. Although there are some varieties in results for different air pollutants or different country pairs, the decomposition analysis shows that the gaps in PIE are mainly caused by the differences in emissions intensity, input structure and value-added ratio between China and selected economies. On the contrary, differences in export structures generally narrowed the gaps in PIE between China and selected economies. In other words, the relatively higher PIE of China mainly results from its dirtier technology reflected by the higher direct emissions intensity of production and more emissions-intensive input structure, while relatively cleaner export structure of China generally reduces the gap in PIE between China and selected countries.

## Study on China's Medium and Long Term Energy Demand Forecasting Model System

Topic: 716E  Special session: SIC-OECD-IDE/JETRO Joint special sessions on Development, Employment and Inequality (2)
Author: Yaxiong ZHANG

State Information Center (SIC) commits to develop Multi-regional Input-Output Models and CGE Model for a long-term, so far, China Multi-Regional Input-Output Models for 1997, 2002 and 2007 and SICGE energy demand forecasting model had been published. Combining Input-Output model with CGE model, this paper intends toadopt the method of top-down and bottom-up to build the energy economy CGE model to forecast China’s medium and long term energy demand by different sectors and energy products. Following the principles of economic activities inducing final energy demand, the primary energy demands are reversely calculated by final energy demand and energy supply and demand balance. On the one hand, our model intends to forecast China’s medium and long-term demand for coal, electricity, oil and natural gas by building a baseline scenario, on the other hand, carrying out comprehensive national energy demand forecasting under multiple policy scenarios, so as to realize the goals of China’s total amount of energy consumption and carbon dioxide peak.

## The Effects of China-US Free Trade Agreement (CHUSFTA)

Topic: 714C  Special session: Computable General Equilibrium Modeling for Policy Impact Analysis
Author: Yaxiong ZHANG

China and the US are the world’s two largest economies, which account for about one third of the value of total world economy. They are not only the world’s largest traders but also the destinations for most foreign direct investment. China-US trade volume grows rapidly, and the US has become China’s largest trading partner and largest investor, while China has grown into the second largest trading partner and the largest source of imports for the US. It will impose a huge economic impact on the two countries and even the world economy if a free trade agreement (CHUSFTA) can be reached between the two countries. Therefore, the two countries propose the establishment of “CHUSFTA” strategic vision at the academic level.  This study uses the improved dynamic GTAP model (GTAP-Dyn with considering GVC revision) to estimate the potential impact of CHUSFTA on macro economy, sector trade, output and employment of the US and China, summarizes and analyzes the “gains” and “losses” CHUSFTA brings to the two countries, thereby supporting the development of CHUSFTA.

## A Quantitative Study on the Problem of Aggregation Bias in Input-Output Model

Topic: 716B  Methodological Aspects of IO Analysis (3)
Author: Zhengxi ZHENG
Co-Authors: Ning CHANG, Mingfang ZHANG

Scholars have done a lot of researches on the problem of aggregation bias in input-output model, but there still lacks an effective solution for quantitative analysis. So some misunderstandings may occur in input-output practice and application, for example, some researchers misuse the degree of aggregation (such as the number of aggregated sectors) as the gauge of aggregation

bias. In view of this, this paper reviews the relevant researches with regard to the characteristics of aggregation bias, and then discriminates different measurement methods of aggregation bias via the discussions of their reasonability and applicability. On the basis of these, we launch an empirical study on the problem of aggregation bias from the perspectives of industrial linkage effect and comprehensive measurement respectively, using the input-output table from National Bureau of Statistics of China and STAN Databases. Our results show: firstly, under the standard of industrial linkage, the overall aggregation bias depends on the heterogeneity degree and the element importance of corresponding aggregated sectors, and the local distribution of aggregation bias rests with the relevance between the object and corresponding aggregated sectors; secondly, under the standard of comprehensive measurement, we design two index: CHI (Comprehensive Heterogeneity Index) and CBI (Comprehensive Bias Index) and find that CHI is the main determinant of CBI, but this doesn't rule out other interference factors whose influence are relatively minor. It is believed that our findings can be positive and useful for the measurement of aggregation bias in input-output models under certain conditions.

## China's energy-water nexus: Spillover effect of energy and water policy

Topic: 714X  Special session: Taxation
Author: Yuanchun ZHOU

The nexus between water and energy is drawing more attention in China today. Large amount of water requirement for energy production drives us to consider the spillover effect of energy and water policies on both resources. Our study builds a multi-sectoral dynamic computable general equilibrium (CGE) model with an energy tax module, to study impacts on energy and water resource. Based on the proposed model, different policy designs with different ad valorem tax rates are simulated. The result shows that energy production and demand would be negatively affected by the reform in terms of output shrinkage in most sectors, and the effect will be larger with a higher tax rate. Energy structure would be improved, with a sharp decrease in fossil fuels production and demand, while the cleaner energy forms will increase. Water resource required for energy production would be significantly decreased based on enengy saving effect of energy tax, which also greatly contributed for the achievement of "3 redlines" goal. Water saving policy can save water of thermal power plants but increase energy consumption. Hence, site-specific factors should be considered in the determination of cooling technologychoosing in different regions of china.

## Trade Costs, Global Value Chains and Economic Development

Topic: 516W  Special session: Global Production Networks: Theory and Empirics (2)
Author: Yuan ZI

This paper develops a model with sequential production stages and international trade frictions that permits an analysis of how decreases in trade costs shape the interdependence between countries, with special focus on the joining and industrialization pattern of developing countries into the global value chains (GVCs). I show that in a two-country setting, a decrease in trade costs of intermediates is associated with South
moving up the value chain and both North and South experiencing welfare improvement, combined with a non-linear wage response. Then I extend the model into a multi-country setting with two simple thought experiments. I show that when global trade frictions fall, South countries

join supply-chain networks due to wage differentials and low trade costs; this increases the North wage but may decrease the wages of an insider South. In addition, ―Factory South‖ are regionally clustered. The model provides a first look at GVCs from the development angle, and raises several interesting policy concerns regarding GVC governance.