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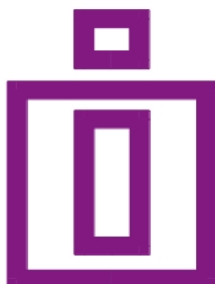


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*BOOK OF ABSTRACTS
AND LIST OF AUTHORS*

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International Input-Output Association

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Final demand impact on agriculture output: A macro multiplier analysis on Nigerian economy

Topic: (5.2) Input-output analysis for policy making (2)

Author: Irfan AHMED

The economy of Nigeria is facing the challenges of inefficiency in agriculture production and insecurity of food. The government of Nigeria has committed to diversify the economy and decided to increase the agriculture productivity that ensures the food security. To this end, several policy options are considered; among them is to increase the production of selected value chain commodities namely rice, wheat, cassava, and fisheries etc.

This study presents the economy of by Nigeria by constructing a social accounting matrix (SAM) for the year 2010. An extended input-output model is calibrated followed by a multiplier analysis. The study conducts dispersion analysis to identify the key sectors which have significant importance vis-a-vis other sectors of the economy. Moreover, a macro multiplier analysis is conducted to depict the interactions between policy objective (total output) and policy control (final demand) at multi-industrial level.

Motivating Factors of Investors to Involve in Supply Chain Management Practices: A study on Ready Made Garment Industry in Bangladesh.

Topic: (4.7) Region/country-specific analysis (1)

Author: Salma Akther

Co-Authors: Al Mamun

Purpose

The purpose of this paper is to investigate the motivating factors of Supply Chain Management (SCM) practices of Bangladeshi ready made garment Industry. SCM activities are key facts for sustainable growth of RMG sector in Bangladesh. This study fills the gap of research on this topic and enriches SCM knowledge enormously.

Research Approach

This descriptive study investigates the motivational factors of SCM. It focuses how the major variables are interrelated with motivating factors of companies to involve in SCM practices. This study also develops a perceptual map of company owner's motivation regarding SCM activities.

Methodology

A survey have been conducted to explore relationship among the considering variables of factory owners motive to involve in SCM. Data were collected through a structured questionnaire.

Sample frame had developed from 43 companies; 10 companies were selected using simple random sampling technique. The final analysis was performed on statistical software based on factor analysis and multidimensional scale technique frequency.

Findings and Originality

Literature review indicates internal forces (Organizational reputation, desired business profit) and external forces (Consumer requirement, reward ratio, competitive advantage) have enforced garments companies to involve in SCM activities. It suggests understanding of motivational factors for SCM can increase productivity, shorten the lead time and convey real business benefits.

Research Impact and Limitations

This study finds four motivational factors (operational, financial, environmental & ethical and

social & behavioral) of supply chain management. The study identifies the sensitivity of each motive along with required strategy for controlling SCM activities. Moreover, it directs positive impression for foreign investors regarding Bangladesh and used to gather experience about motivational aspects of SCM activities for others as well. Although this study focus only the area of Bangladeshi RMG industrial but it may helpful as a foundation for further study.

Key Words: Supply chain management, Motivation, Garments, Bangladesh.

International Fragmentation of Production and Insertion of Brazil in Global Value Chains

Topic: (8.8) Global Value Chain and Vertical Specialization (2)

Author: Inácio Fernandes de Araújo Jr

Co-Authors: Fernando Salgueiro Perobelli, Weslem Rodrigues Faria

The intensification of trade through global supply chains, with the processing steps distributed across countries, has enabled companies to relocate substantial parts of production to cheaper foreign locations. Thus, the production processes are increasingly split into separate activities and countries specialize increasingly in particular stages of assembly and processing. This international fragmentation has been defined by the specialization of the production process through vertically connected stages. So, global value chains are often analyzed by the identification of the origin of value added in international trade.

However, it is still unclear to what extent this international fragmentation is essentially occurring within groups of neighboring countries and regional trading blocks, or mainly global, involving countries from different regions. Thus, despite the fragmentation of production processes are commonly referred to as “global” production chains, empirical evidence suggests, however, that many of these chains can be described as “local” production chains, as they include geographically close countries. Therefore, vertical specialization would be marked by regional blocks, rather than the supply chains global. Hence, it can be expected increases in international fragmentation over time focusing of immediate commercial partners. Moreover, there are industrial differences in this regional concentration patterns. While some industries locate their assembly activities close to the final markets, with specialized suppliers tending to cluster around these assembly activities, other industries concentrate the activities required to produce increasingly dispersed around the world.

The main objective of this study, therefore, is to analyze Brazil's insertion in the international trade vertical specialization process. This analysis allowed understand the evolution of international fragmentation of Brazilian production from the participation of foreign content in production. Thereby, the degree of integration in production chains was identified by type of economic activity and the origin of foreign value added included in production. For this purpose, we use the input-output methodology and the GTAP 9 Data Base assembled by the Global Trade Analysis Project. The GTAP data includes bilateral trade statistics and input-output tables for 140 regions and 57 sectors. The analysis was carried out for the years 2004 and 2011.

Thus, from this analysis it was possible to trace the geographical origin of the trade networks in order to evaluate to what extent the inclusion of the Brazilian economy in production chains are truly global. Furthermore, since the intermediate inputs cross borders multiple times could have double counting in the trade statistics. In this way, we consider both the foreign value added and the importation of value added that Brazil may have insert the initial stages of the production process. Hence, this analysis allowed estimate the contribution of domestic value added in

Brazilian exports.

Regional effect of energy reform in Mexico: a computable general equilibrium model for Tabasco

Topic: (6.4) CGE Modelling (3)

Author: Aída B. Armenta

Co-Authors: Diane Flaherty, Billl Gibson, Jorge Salazar-Carrillo

This paper presents a dynamic compact computable general equilibrium for the state of Tabasco, Mexico. The data used for the exercise is a social accounting matrix for Tabasco, developed by one of the authors. The simulations are original and address pressing policy problems faced by Mexico as it undergoes constitutional reform in the context of sharply lower world prices for petroleum. The research question is whether the region would be better off with one of two strategies:

- 1) developing its deepwater oil reserves, in which significant resources would have to be devoted to increasing the supply of highly trained and specialized skilled labor for the petroleum sector or
- 2) pursuing a educational strategy that does not prioritize the petroleum sector, but rather offers advanced education more broadly.

In either case, Tabasco will have to increase the flow of benefits from the petroleum sector that historically have been controlled by the state and PEMEX. This has been nearly impossible in the past, but the petroleum reform offers new opportunities, however, since regions can potentially tap resources of private sector entities for the purpose of local infrastructural investment.

The costs and benefits of different approaches to reform are explored through numerical simulations. On one hand, "aguas profundas" is a more profitable path that causes faster growth, but does not break with the traditional resource curse that has plagued Mexico and many other countries. On the other hand, local universities, through enlightened leadership and development, would aggressively respond to the demand for education in a range of critical fields, such as medicine, agricultural and industrial engineering and legal services. The effects from directing the benefits of petroleum sector reform toward these fields are shown in a second simulation. This strategy, "la reforma", confers benefits that are almost as large but carries less risk than the specialization implied by "aguas profundas". The paper is agnostic about which approach should be chosen, but clearly identifies relative costs and benefits as a guide to policymakers making the choice. It is concluded that Tabasco must continue to respond both to the "race between technology and education" and to "the interminable dance between progress and inequality."

A proposal for the construction of a input-output regional model from bottom to top by hybrid Methods

Topic: (7.3) Regional input-output modeling (1)

Author: Normand E ASUAD

The main purpose of this essay is to develop a methodology and its application for the construction of an input output regional model, which, based on a bottom-up approach and in a hybrid approach, allows us to pick up the essential aspects of the particularities of the economy of a region and its adequate combination with the national data. This is done through the construction of a basic regional statistical system by which regional data lead us to orient the

process of regionalization of the national accounts and the construction of the key variables for the construction of the regional supply and use input-output tables. In our view this fulfill the regional data requirements and the use of superior data at national level, making possible the construction of regional IO matrixes by a bottom-up approach.

It is known that the methodology for the construction of an IO regional model depend on the regional disposable data, the information data plays a key role in the construction of an IO matrix. As a matter of fact his construction is supported in a statistical system, which relies on the elaboration of the national accounts. This is one of the main achievements that lead internationally to develop the IO national matrixes and their use as basic tools of the national economic performance

According to Miller and Blair 2009, among the most formidable challenges in using input-output analysis in practice is assembling the detailed basic data needed to construct input-output tables characterizing the economic area of interest - national, regional, or perhaps multiple-regions.

The argument that the lack of regional data is the main cause that the regional IO matrixes be built depending on national IO, has its roots according, to our view in the lack of a regional statistical system that enhance us to elaborated regional accounts and the basis under which the IO regional matrix can be built.

Nevertheless, depending of the national statistical system, particularly to the development of the national accounts and the regional disposition of data is possible to establish a data base in order to estimate through hybrid methods the key regional variables that are crucial for the construction of a regional input-out table.

In the case of Mexico we have a solid system of national accounts as well as consolidated accounts at national level of both non-financial corporations, government, institutions and no profit-making sectors. Besides we have estimations of the value added for the federative entities of the nation, considering the sectoral classification of the North American Industrial Classification System (NAICS)

Therefore we assume that the results that come about from this research, it seems to me that they can contribute to the development and application of a methodology for the construction of regional matrixes from bottom-up approach.

Furthermore in the literature there are few and important recommendation concerning the regionalization procedures for the construction of a input-output regional matrix by the construction of regional accounts, considering as a key feature the regionalization of national tables: Jackson 1998 and Lahr's 2001. In México to my knowledge there is not such type of analysis.

Therefore our main interest is to develop a methodology based on the creation of a regional data base that lead to built of a supply and use regional matrix and regionalize the national table and the creation of the regional make and use IO tables, taking into account the regional data and its combination with the national one based on hybrid methods.

Finally in order to show some empirical results we take the state of Sonora as a case study. The methodology that we developed comprises the following: 1. Review of the main theoretical concepts and of the input-output regional models; 2. The methodology proposal: 2.1 Identification and demarcation of the spatial economic functional units (SEFUs); 2.2 Estimation of the basic

data for the construction of Input-output regional model and 2.3. Construction of the input-output regional model.

Therefore the essay consist of the following parts: 1. Review of the main theoretical concepts and of the input-output regional models; 2. The Methodology proposal and 3. Preliminary empirical results.

Dynamic Input-Output Model of Russian Economy with Human Capital Block.

Topic: (4.6) Special Session: Input-output Approach and Impacts of Economic Policy in the Emerging Markets (2)

Author: Alexander O. BARANOV

Co-Authors: Victor Pavlov, Yuliya M. Slepenskova

Baranov A., Pavlov V., Slepenskova Yu.

The Dynamic Input-Output Model of Russian Economy with Human Capital Block

The research question

The accumulation of human capital is an important factor of economic growth. It seems to be useful to include «human capital» as a factor of a macroeconomic model. Most of the models usually distinguish labor force by the levels of education, while some of the factors remain unaccounted. Among them are health status and culture development level, which also influence on labor productivity. Inclusion of the human capital block to the dynamic input-output model can help to make it more reliable for economic development forecasting.

The method used

The basic DIOM, which is developed in this paper, was first described in [1]. Later it has been developed in several directions including a version of the model with fuzzy parameters [2].

The model includes n sectors. Among them $1, \dots, k$ can be defined as asset-building sectors (production of machines, equipment, structures), $k+1, \dots, l$ as sectors which produce human capital, $l+1, \dots, m$ as non-asset-building sectors in the first subdivision (production of raw materials and intermediate services) and $m+1, \dots, n$ as non-asset-building sectors in the second subdivision (production of consumer goods and consumer services for households).

The model uses the following parameters:

m - the number of the first subdivision sectors ($m < n$);

k - the number of asset-building sectors;

l - the number of human capital investment types;

T - years of the forecast period.

The basic model is extended with additional equations that allows to model human capital reproduction.

1. The equation that describes the formation of human capital of type i put in service in each sector j in period t as a result of investment in human capital in previous years.
2. The equation that describes the relationship of investment in human capital type i in sector j at period t with the output of students for the period of time t
3. Recurrent equation for re-calculating of “construction-in-progress” of human capital of type i in sector j (i.e. people who continue their education or medical treatment) for every period t .
4. The equation describing the dynamics of the human capital value of each type i in each industry j in each year of the forecasting period t .
5. Constraint which characterizes the fact that in each year of the forecast period t in the

economy cannot be used the human capital more than the value of its available.

The data used

Forecast calculation using the dynamic input-output model with a block of human capital is carried out using statistics of the Russian economy.

The novelty of the research

In this paper, in the construction of the block of human capital in a dynamic input-output model uses the idea of human capital modeling, by analogy with the modeling of fixed assets reproduction. In addition, currently not developed dynamic input-output models of the Russian economy, which include a block of human capital.

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Smart, sustainable and inclusive growth: a case study

Topic: (7.5) Input-output analysis for policy making (3)

Author: Margarita I. BARRERA LOZANO

Co-Authors: Geoffrey J.D. HEWINGS, Alfredo J. MAINAR CAUSAPÉ, Julián Pérez-García

This paper explores the strengths of intersectoral and interregional linkages of the optical sector in the frame of European strategy for smart specialization. The European Optician2020 project seeks the creation of a production model based on the creation of personalized spectacles through local manufacturing, meeting all the criteria for the smart specialization strategy: smart, sustainable and inclusive growth, thus providing a reference for a case study. In order to ascertain to what extent the promotion of the sector can benefit economic growth, an economic model is constructed using an interregional input-output database for the Spanish economy, and the quantification of linkages is made with input-output techniques to highlight the different role that the industry plays in different regions and to examine the nature and strength of its sectoral interdependencies. Complementary analysis examines the degree of clustering in this sector. Finally an overall assessment of the sector's role will be provided focusing on indicators such as employment, income and production.

The Cost of Compliance to the Paris Agreement and its Distribution: An Input-Output Analysis of the Canadian Economy

Topic: (9.6) Environmental IO Modelling (6)

Author: Louis-Robert Beaulieu-Guay

Co-Authors: PAUL J. THOMASSIN, Kakali MUKHOPADHYAY

According to its Paris Agreement commitment, Canada must find a way to substantially reduce its greenhouse gas (GHG) emissions. However, given the Canadian political system, where regulation and taxation powers are divided between different levels of government, a nation-wide action plan against climate change calls for a high level of coordination and agreement between provinces. The goal of this research is to propose a way to limit Canada's GHG emissions without placing an unacceptable burden on the highly emitting provinces.

Using a subnational multiregional input-output model with interprovincial trade and GHG emissions, the economic impact of a carbon pricing policy will be assessed according to two scenarios. The first scenario will evenly allocate the GHG emission reduction across all industrial sectors. The second scenario will put the burden of the abatement costs on the largest GHG emitting sectors of the Canadian economy.

By simulating these different policy scenarios, this study will look at the trade-offs between their overall economic costs, the GHG emission reduction, and the geographical distribution of those costs amongst provinces. Distributing the GHG cut evenly across industrial sectors is expected to be a high cost alternative, however, targeting only the highest GHG emitting sectors will place a large burden on the western provinces, preventing the policy to be implemented in Canada. A compromise between these two scenarios would need to be negotiated.

Effects on prices of an increase of the tariffs in Mexico through a Social Accounting Matrix.

Topic: (5.3) International Trade (2)

Author: Luz Dary Beltrán Jaimes

Co-Authors: Manuel A. CARDENETE, María C. Delgado

With the arrival of the new president of the United States, Donald Trump, it is expected that the treaties of free trade and commercial pacts present a setback, as he has previously suggested during his election campaign. His proposal is to impose taxes on imports to both China and Mexico and tax companies moving to these countries. This could bring great effects to the Mexican economy due to the importance of trade relations with this country, because the United States is Mexico's main trading partner, which allocates almost 50% of its imports and 80% of its exports. Therefore, the goal of this research is to simulate the possible effects of the 20% increase in tariffs on the Mexican economy. The price model used is based on a general equilibrium linear model. With this price model, the estimate of the impact of the effects of a US tariff increase of 20% on the Mexican economy is roughly estimated, simulating this increase on prices in the rest of the world. In this way, it is possible to calculate the effects on consumer prices and welfare represented in this case by the CPI. The main result shows that the impact of the increase of the prices of the rest of the world to the increase of the tariffs in the United States on the CPI is inflationary with an increase of around 4%.

Multisectorial Analysis and Structural Change of The Mexican Economic for 2008-2012

Topic: (8.5) Impact Analysis: Multipliers (2)

Author: Luz Dary Beltrán Jaimes

Co-Authors: María C. Delgado

In this paper an analysis of structural change for the period 2008-2012 is performed, from the social accounting matrix constructed for Mexico for each of these years, following a methodology of linear multiplier. For this, first, key sectors are determined, followed by Economic Landscape to identify intersectoral relations, accounting multipliers are decomposed to determine the direct, indirect and induced effects of an exogenous unit impact and finally determine labor multipliers. Among the main results we are that by 2012 was obtained as a key sectors to Trade and Real Estate Services, while for 2008 only was detected as the key to Commerce. Similarly, it was identified that the manufacturing industries and real estate services reflect the increased economic impact to interact with all productive sectors. About multiplier decomposition, for both years is detected that the sectors as greater overall effect on the economy are health services, educational services and legislative activities, which for one year to another only changes its position and level of impact. Finally, the sectors with the greatest capacity to generate employment for that period remain stable, with the largest capacity the primary sector, followed by other services and support services business. This research is important, since identifying structural change is fundamental to define the new course that policymakers should take in any field. In addition, the issue has not been addressed at present.

Are High Output Linked Sectors Employment Generating? An Analysis for India under Input-Output Framework

Topic: (7.2) Employment Analysis

Author: Tulika Bhattacharya

The paper identifies the key employment generating sectors of Indian economy for pre and post liberalization period by way of measuring their employment forward and backward linkage effects using six Input-Output tables for India, which measures the direct and indirect employment creation by these sectors. The paper also examines the output generation capacity of these sectors by calculating their output forward and backward linkages in order to determine whether the key employment generating sectors are also output generating or not. Results show that sectors like agriculture, tobacco products, wood and wood products are key employment generating sectors possessing high employment linkages, although their output linkage is not very high, which reflects the incidence of jobless growth in India. However sectors like, mining and quarrying, food products and beverages, textiles, hotels and restaurants are having a reasonably good output as well as employment linkage for both pre and post liberalization periods.

Biofuels versus electricity: Impact of their increased production on household welfare, sectoral and overall output

Topic: (1.4) CGE Modelling (1)

Author: Emmanuel Bizimungu

Co-Authors: George Danso

For many decades, Uganda's energy challenges remain unresolved. Yet, a country's economic growth is essentially driven by energy accessibility and affordability. Uganda's case is quite interesting because electricity is not only limited in supply and access, prices have also soared. How a developing country like Uganda can attain a middle income status amidst unresolved energy constraints is an interesting and important research issue. Moreover, environmentally-unfriendly biofuels continue to dominate the country's total energy consumption although it is hoped that initiatives that convert waste resources to environmentally-friendly biofuels will not only replace their use but will also augment overall energy needs. Whereas the former guarantees increased energy security, this is only true in the short run. This raises sustainability concerns due to obvious challenges ranging from tradeoffs between food and biofuels production to accelerated deforestation and desertification aggravated by high population growth rate, increased urbanization and industrialization.

Using Uganda's SAM 2009/2010, we aggregate wood charcoal and firewood sectors into broad biofuels sector and then employ a CGE model to evaluate the economic impacts of increased environmentally-friendly biofuels and electricity. We extend this analysis to consider potential inefficiencies associated with increased electricity prices. The analysis reflects one important reality; biofuels link multiple sectors of the economy due to the use of agricultural land resources for biofuels production, and potential substitutability among alternative sources of energy.

Relative to the baseline, both cases of increased biofuels production and electricity supply yield significantly higher GDP with growth in the latter case being the highest. Household welfare improves in both cases but the overall increase in household income is higher in former case. Agricultural employment shrinks and so is value-added. Although the biofuels policy more than offsets most negative effects of increased electricity prices, joint implementation is more beneficial if coupled policies are expansionary in nature.

Tracing Shifts in Dependencies on Trade: The Rise of Services

Topic: (3.3) International Trade (1)

Author: Timon I. BOHN

This paper explores the understudied role of services in international trade and value chains. I employ value-added and gross export based trade indicators to address the following questions: i) evaluate whether services trade is rising in importance over time, ii) consider whether services trade travels further than trade in manufactured goods, and iii) investigate recent trends in world trade and the possible impact of services. The study makes use of the World Input-Output Database (WIOD) and includes 35 countries across three regions: Europe, North America, and East Asia. I find that dependence on value-added trade in services rose faster than dependence on value-added trade in manufacturing as a share of GDP and final consumption in two of the regions. Services are also more prominent in interregional relative to intraregional value-added trade flows compared to manufactured goods. The findings suggest that trade has become more global in the period 2000 to 2014 from a value-added perspective. They help to resolve an

apparent paradox on the nature of globalization in a world of international production networks.

From convergence to divergence? : The experience of the European Union

Topic: (6.7) Region/country-specific analysis (2)

Author: Lucía BOLEA

Co-Authors: Rosa DUARTE, Julio Sánchez Chóliz

The European Union was built with the aim of creating a union, not only monetary, but also social between the European countries. The implementation of measures to reduce the existing gap between the member countries paid off. But without a doubt, the arrival of the euro as a single currency and the elimination of trade barriers meant a relevance change in the quantity and type of trade between European countries and trade between them and the rest of the world.

In the context of an international economic crisis, the discussion on the role played by the European Monetary Union has been revitalized, with open questions such as the existence of convergence or not between the Member States of the European Union.

This paper attempts to shed light on the convergence and divergence process experienced by European countries over the last few years and in particular, the role that some economic sectors, such as high technology sectors, have played as drivers of that process. Specifically, we analyze whether there has been such a social and economic integration that was intended to create between European countries, or really there are still differences between them.

Based on a multi-sectoral and multi-regional input-output model, we study σ -convergence and β -convergence between European countries over the period 2000-2014. We also analyze the impact that this process of convergence, or not, has had in each country, and in the EU as a whole. We discuss the role that trade (both intra-EU and extra-EU) has played in the evolution of these parameters in the context of the European Union. To do this, the new release of the World Input-Output Database (WIOD) is used.

Brazilian Monetary Policy Evaluation using Flow of Funds Analysis

Topic: (8.5) Impact Analysis: Multipliers (2)

Author: Erika BURKOWSKI

Co-Authors: Jiyoung KIM, Kazusuke TSUJIMURA, Masako TSUJIMURA

This paper presents the Flow-of-Funds Analysis applied to the evaluation of the monetary policy conducted by the Central Bank of Brazil and its effects on the other Institutional Sectors between 2004 and 2009. In this period, the world economy suffered a shock due to the financial crisis that was triggered by the collapse of the U.S. subprime mortgage market and the subsequent bankruptcy of the Lehman Brothers Investment Bank. The Brazilian economy also experienced this effect with a large drop in the growth rate of the economic production and the fixed investments. So we intend to investigate the monetary policy carried out by the Central Bank of Brazil to evaluate its effectiveness. The method used is the Flow-of-Funds approach which is an application of Input-Output approach to an Asset Liability Matrix (ALM). The ALM is a square matrix that shows the flow of funds between institutional sectors in an economy. This paper presents the Flow-of-Funds Accounts of the Brazilian economy in two matrix forms: the Klein formula, which is based on the asset portfolio, and the Stone formula, which is formulated on the liability portfolio of the sectors. Both of them are used to assess the induced demand and supply of funds. Since they represent gross induced saving and investment respectively in the real

economy, it is possible to assess the net induced investment, which can be an indicator of the effectiveness of the monetary policy. We expanded the Flow of Funds Accounts in the financial balance sheet format published by the Central Bank of Brazil by subdividing the financial sector using the balance sheets of the financial institutions. The ALM developed have ten (10) institutional sectors: households, enterprises, government, rest of the world, Central Bank of Brazil, Banco do Brasil, Caixa Economica Federal, Banco Nacional de Desenvolvimento Econômico e Social (the financial institutions that are financed by the government), Itau (the largest private bank in Brazil) and the “others financial institutions”. Although the fundamental analytical method is based on Tsujimura and Mizoshita (ESR, 2003), the method has not been applied to Brazil nor any of the countries on the American continents. Since Brazil has not a few special purpose financial institutions as listed above, we are to evaluate the policy-propagation process through the financial system unique to the country.

What is the Potential of Natural Resource based Industrialization in Latin America? An Input-Output Analysis of the Extractive Sectors

Topic: (10.1) Emerging developing countries

Author: Beatriz Georgina Calzada Olvera

Several case studies have analyzed the potential of natural resource (NR) based industrialization, a process based on diversification towards high value added products, in the Latin American region. However, there is limited evidence on how the development of productive linkages, a key aspect of this strategy, behave at the country level. Resorting to input-output analysis, this paper provides a clearer picture of the extent and evolution of productive linkages of NR sectors across a sample of middle- and high-income countries in Latin America as well as in other developing and developed regions. The paper focuses on the degree to which extractive industries, i.e. oil, gas and mining, are connected to the rest of the economy by studying both backward and forward linkages using OECD IO data. It also makes a distinction between local and foreign inputs to account for the level of integration that these sectors have into global value chains and/or imports dependence. Furthermore, it tries to identify whether the level of extractive sectors' importance in exports and the total economic output is related to the level of intersectoral linkages. Ultimately, it seeks to respond whether extractive industries are still considered enclave as the Dutch disease hypothesis suggest.

Distributional consequences of fiscal consolidation: The case of Spain

Topic: (4.5) CGE Modelling (2)

Author: Pilar CAMPOY-MUÑOZ

Co-Authors: Manuel A. CARDENETE, Francisco Javier De Miguel-Velez, Jesus Pérez-Mayo

The Great Recession has led an uneven increase in public debt for most of advanced economies, raising concerns about fiscal sustainability. A growing body of literature are focused on the macroeconomic consequences of fiscal adjustment but the research about microeconomic effects and especially distributional effects remains fairly limited. In this paper, we analyze the effects of austerity measures on inequality, as maintaining deficit reduction efforts is difficult when it is perceived as unfair. Moreover, a resulting high income inequality could harm the growth in the medium-term. To do so, we integrate a Computable General Equilibrium (CGE) model and a

microsimulation model for the Spanish economy in 2015, within a top-down approach. The results will show the effects on income distribution of a hypothetical reduction of public deficit until 3%, as required by Stability and Growth Pact.

Regional Input-Output for the Sub-Middle Hydrographic Region of the São Francisco River Basin in Brazil.

Topic:

Author: Ana Cristina Guimaraes Carneiro

Co-Authors: Ignacio Tavares Araujo Jr, Márcia Guedes Alcoforado de Moraes

In the last years, the Brazilian government has been investing large amounts to expand the water infrastructure to provide water to new irrigated areas especially in the Northeast of Brazil, the poorest region of the country. Undoubtedly, the main effort on this direction is transposition of the São Francisco River which involves resources on the order of US\$ 2.7 billion. It's worth noting that supply or demand management of water across the hydrographic basins is necessary given the potential conflicts in water use due to low productivity of irrigation schemes in the Northeast and the increasing necessity of water availability for other purposes. Under this scenario, this paper uses a regional Input-output matrix for the Sub-Middle hydrographic region of the São Francisco river basin (IO-SMSF), to simulate economics impacts induced by water availability. The availability of technical coefficients of direct use of water for the Brazilian economy enables the assessment proposed in this paper. The regionalization of the input-output system was carried out using the Cross-Hauling Method. The main data used was the Brazilian Resources and Use Table, the Brazilian regional account system and the GDP of Brazilian Municipalities. The results may indicate that new ecological demands (minimum reservoir release), if imposed, can lead to high costs for irrigated agriculture and energy. On the other hand, it can point out which activities have been associated with this new scenario, such as tourism for example.

Construction sector in the state of Pernambuco: a reading from the input-output matrix

Topic:

Author: Ana Cristina Guimaraes Carneiro

Co-Authors: Dinilson Pedroza Junior

The present paper proposes a simple way of elaborating a regional input-output matrix for a non-developed country and uses it to address the construction sector. Poor societies have not a sophisticated national agency of statistics so as to produce data that permits an elaboration of a "survey" input-output table. Where local data are not available, researchers and policy makers in general need to use a "non-survey" method to obtain a regional input-output table. One of the major problems in building an input-output matrix is the scarcity of data about exports and imports between regions of a country. One of the most efficient methods to estimate the trade flux in regional dimension is the Cross-hauling. The Cross-hauling method used here to regionalize national data was checked with actual import and export data, to evaluate the precision of that method. Besides its huge environment impact, the construction sector is one with expressive social vulnerability (the theme of the 2014 UN Human Development Report). A regionalization of a national input-output matrix was applied to Pernambuco, Brazil, a state with one of the worst HDI of the whole country. The paper shows how a regional input-output analysis can be used in social and environment studies in poor countries.

Exploring youth labor perspectives in Europe using demo-economic models

Topic: (6.1) Special Session: Income distribution in IO models: Miyazawa revisited (1)

Author: Andre CARRASCAL

European economies have serious structural problems with offering employment to the young population. The severity of this issue increases when we consider that during the crisis, the chances of unemployed young people getting a job were very low (only 29.7% of those unemployed in 2010 found a job in 2011), according to the European Labor Force Survey (LFS). The analysis of this subject gains a special relevance due to the substantial differences existing between Member States. Northern countries like Germany (7.9%) or the Netherlands (11.0%) had very low youth unemployment rates in comparison to Southern countries as Greece or Spain, which reached dramatic levels of 58.3% and 55.5%, respectively. The main aim of this paper is to analyze the labor market perspectives of the workforce by age for the EU-15 countries, exploring the elements of the extended Leontief inverse, specially the interaction between demographic and economic activities. Moreover, this paper studies the relationship between Type II multipliers that comes from Miyazawa models and the so-called type IV multipliers, offering a deeper view on the processes of income distribution in Input-Output. Using the information available in the World Input-Output Database for the year 2011, a multiregional demographic I-O model is proposed, following Batey-Madden methodology.

Now Hiring: Seasonal Labor Requirements through a Quarterly I-O model

Topic: (7.6) Special Session: Disaggregation techniques for IO modelling

Author: Andre CARRASCAL

Co-Authors: Andre Fernandes Tomon Avelino, Alberto Franco Solís

After almost a decade of economic recession, unemployment rates have started to decrease across nations, and growth has slowly resumed. Nonetheless, the recovery in Spain has been slower and the composition of jobs has changed significantly from the pre-crisis period, with a higher share of temporary contracts. This has translated into increased variability in the employed-unemployed condition of the labor force along the year, which ultimately impacts seasonal final demand. Despite capturing economy-wide effects, current Input-Output models are still limited in their assessment of intra-year shocks because they are based on annual accounts. Hence, traditional employment multipliers per se offer little insight into these issues. Moreover, although demo-economic models introduce different labor statuses and consumption profiles, they also have an annual basis. In sum, intra-year seasonality in labor requirements has been largely ignored in the Input-Output framework, relying on a temporal aggregation that prevents capturing such employment movements. This topic is particularly important for impact assessments, especially in the case of those sectors involving seasonal production, such as some primary and services activities. Therefore, the aim of this paper is to introduce an Input-Output framework that merges intra-year tables and a cost-share model of employment requirements that yields jobs by contract duration and quarters, and inter-temporal production levels. This model follows the T-EURO method proposed by Avelino (2017) and an econometrically estimated translog cost function in line with Kim and Hewings (2015). This paper uses data from the World Input-Output Database and the Continuous Sample of Employment Histories for Spain to illustrate its application.

The South American Input-output Table : Key Assumptions and Methodological Considerations

Topic: (10.2) Special Session: The Current State & Future plans of Global MRIO databases (2)
 Author: Sebastian Castresana

The main goal of this paper is to explain the key assumptions and the methodological considerations on the construction of the South American input-output table (IOT) for 2005. The greatest contribution of the project, next to the integration of ten national IOTs and their interconnection, is made by the inclusion of countries for which no IOT were available or where those existing belonged to a year very distant from 2005 and, therefore, additional work was needed to transform the supply-use tables available from official sources (central banks and statistical offices) to such IOT compatible with the information from other countries in the project. The South American IOT consists of matrix with 40 sectors at basic prices.

Getting to the final IOT was neither a simple nor immediate exercise, and required a process that took several steps and specific milestones. The first milestone was undoubtedly the assembly of each of the national IOT correlated to the 40 sectors chosen for the South American IOT. A second milestone was to prepare the national information to be compatible to that of the other countries included. This exercise included: i) The resolution of particular arising issues in obtaining information for 40 sectors such as opening aggregate sectors; ii) Opening of the intermediate use in domestic and imported inputs; iii) Valuation of all transactions at basic prices, i.e. excluding taxes and margins, but covering subsidies in cases where those existed; iv) Valuation of all transactions in 2005 dollars; v) Opening of imported intermediate use by origin, particularly of South American origins; and vi) Opening of trade in services by origin. Once finished all the exercises of harmonization and the preparation of bilateral trade flows of goods and services, the assembly of a first South American IOT that included 10 South American countries was achieved. While, there have been efforts to analyze the existent links at the regional level derived from international trade statistics, a work of the presented magnitude has not been deployed before. This is especially valuable as the same work has been announced to be the most accurate method to address the study of regional and global production chains in Latin America and the Caribbean. The South American IOT is a good starting point for the analysis of both domestic and foreign linkages at the South American level. Still, there is the need to move towards the broader objective of having a Latin American IOT. For this purpose, ECLAC is making efforts to complete a similar IOT for the rest of the countries of Central America and the Caribbean that are not included in this exercise. Likewise, for the purpose of conducting analyses of structural changes over time, tasks were developed to prepare a comparable IOT for a more recent year.

Sectoral Impact on the Reduction of 40% of Foreign Direct Investment from the United States to Mexico

Topic: (3.2) Impact Analysis: Multipliers (1)
 Author: LILLIAN MARLEN CENTENO CRUZ
 Co-Authors: Luz Dary Beltrán Jaimes

In this paper we formulate a linear general equilibrium model with the aim to analyze how Gross Domestic Product impacts if United States direct investment in Mexico is reduced by 40%, the model considers the proportion of investment that is destined to the 17 productive sectors in Mexico from direct United States investment and the proportion of direct investment received per country during 2016 considering the dollar exchange rate for the same year, for the development of the model is impacted to Gross Domestic Product reducing its input by 40%. As a first result it

was found that the direct investment of the United States to Mexico represents 35.70% of the total foreign direct investment received, reason why a reduction of 40% would represent a loss of \$ 52,692,716,468.90 millions of pesos, so that the sector most affected With this reduction is the manufacturing industry since it is the one that receives 62% of the direct investement, with a reduction in private investments, companies stop demanding labor increasing unemployment resulting in the population demanding fewer products because they dont have money to expend due to Low purchasing power these effects cause contracting the market, causing a slowdown in the country's growth.

Suburban Carbon Footprints of a Global City: The Case of Sydney

Topic: (8.6) Special Session: Consumption-based accounts for global cities: data, methods and analysis

Author: Guangwu CHEN

Co-Authors: Lei Shi, Thomas O. WIEDMANN

There is an urgent need for cities to take more ambitious actions against climate change, as current targets can only deliver about half of the carbon savings required to meet the Paris agreement goals. Suburbs are the focal point of the emissions mitigation for cities under the background that many countries around the world are undergoing suburbanization in terms of intensely and diversely suburban development. Previous suburb-scale studies have demonstrated the mitigation potentials in urban planning using economic input-output life cycle assessment at national scale combing with the household survey data. However, there is a need of suburb-scale multiregional input-output (MRIO) table to model the suburbs specific carbon intensity showing the heterogeneity of production in different suburbs. In this study, we first show household Carbon footprint (CF) breakdowns into 111 sectors at 248 divisions of Greater Sydney by employing a suburb-scale MRIO model. The CF of transport sector is further divided into direct private, indirect private, public and infrastructure. We model the change of household CF with a time series of data during 2009-2015, and allocate them to different ethnical immigrant groups. The implications of mitigation for ongoing metropolitan planning are discussed to the end. The results suggest that residents in highly dense inner city core generate a total CF as high as residents in disperse outer city suburbs.

The economic impact of healthy eating as part of Scottish climate change policy

Topic: (2.2) Environmental IO Modelling (2)

Author: David Comerford

Co-Authors: Grant Jordan Allan

Recently, the Scottish Government's Climate Change Plan has set out ambitious targets for the reduction by 66% from 1990 levels. This also notes the important role, and necessary changes, for the agriculture sector in contributing to this target. Research from scientists at the Oxford Martin School, reported upon earlier this year, stated that "adhering to health guidelines on meat consumption could cut global food-related emissions by nearly a third by 2050". In this paper we model the impact upon the wider Scottish economy and Scottish-level emissions measures if households in Scotland were to reduce their meat consumption along these lines.

In this initial exercise, we use an environmentally augmented Input-Output (IO) methodology, with a disaggregated agricultural sector, to track the impact of such a reduction in household

demand for meat upon domestic agricultural production, upon key economic aggregates such as Scottish GDP and employment, and on Scotland's overall greenhouse gas emissions. This analysis shows the sectoral breakdown of these aggregate impacts, and may be extended to show how they split along other dimensions e.g. geographic splits, or split by skill level etc.

We set out two future ambitions for this work: first, extending the analysis to consider other ecosystem services and natural capital stocks associated with agriculture, drawing upon evidence from the Scottish Government's Natural Assets Strategic Research Programme; and second, how our results would vary when implemented within a computable general equilibrium (CGE) model in which we can more naturally consider the system-wide impacts of price or productivity changes.

Regional SAM of Northeastern Mexico: Economic impacts of exports variations.

Topic: (7.3) Regional input-output modeling (1)

Author: Alejandro DAVILA FLORES

1. What will be the economic impacts in the northeastern region of Mexico, composed by the states of Coahuila, Nuevo León and Tamaulipas, associated with a contraction in its international exports due to tightening of trade policy in the United States of America?

2. An expanded Leontief model, elaborated with the data of a regional social accounting matrix (RSAM) for northeast of Mexico, will be used to build a production model and to calculate the multipliers, elasticities and additive decomposition formulated by Stone (1985). Also, we will estimate the impacts on income distribution and household consumption. For the RSAM, we will use the notation proposed by Holland and Wyeth (1993) and later used in Miller and Blair (2009, pp. 514-555). The method employed for regionalization of NIOT was proposed by Flegg and Thomo (2016).

3. National Input-output table (NIOT), accounts by institutional sectors and regional income surveys are used to build a regional social accounting matrix (RSAM) of Northeastern Mexican Economy. RSAM is composed with 31 sectors of economic activity and consumption is broken down into ten groups of households according to their income levels. Capital, government, rest of world and rest of country will be exogenous variables.

4. This is an applied Regional Economics research. The main interest lies in addressing a relevant issue in the current economic situation.

Evaluating the socioeconomic and environmental implications of the Spanish Renewable Electricity Promotion Policy in the decade 2000-2012 using Multiregional Input-Output Analysis

Topic: (3.5) Designing of Energy Policies with I-O

Author: Cristina DE LA RUA

Co-Authors: Yolanda LECHON

Energy has been one of the main drivers of economic growth for societies along the history. But at the same time, it is still responsible of many environmental impacts, being one of most relevant climate change. Fossil fuels have been intensively used in the energy and transport

sectors, causing their depletion and increasing the greenhouse gas (GHG) emissions concentration in the atmosphere. Society concerns for environment and sustainable growth have put pressure on policy makers so that other alternative energy sources are promoted. Based on this, several objectives and targets have been set by many countries to increase the role of renewable energy in the energy transition towards a low carbon economy.

Spain, as a Member State of the European Union, has made important efforts in the last decade to achieve the committed targets (20% of final energy consumption from renewable energy by 2020 and 27% of final energy consumption from renewable energy by 2027). Besides the reduction of GHG emissions, energy transition towards renewables can bring other positive impacts such as a decrease of energy dependency, the improvement of the balance of payment and the stimulation of the economy.

In this sense, the proposed study aims to analyze the energy transition in Spain from 2000 to 2012, focused on the electricity production. At the beginning of this period, 36% of the electricity was produced from coal, 9% from natural gas while renewable energy had a very low contribution (around 2% excluding hydro). At the end of the proposed period, the contribution of renewable energy has increased to around 24%, while there has been a decrease in the use of coal (16% of the share). The socio-economic effects of this transition, in terms of value added and job creation, as well as the environmental implications, in terms of GHG and cumulative energy demand are here estimated. An Environmentally Extended Multi-Regional Input-Output Framework together with process-based LCA emission factors for the different energy technologies are used to analyze the whole life cycle and therefore the whole supply chain, taking into account the economic relationships, both direct as fuel suppliers and indirect, among the countries. The World Input-Output Database, together with other public data will be the base of the analysis.

Converting US Supply and Use Tables into NACE / CPA

Topic: (9.4) Special Session: From USA national Supply, Use and Input-Output compilation to European standards

Author: Pille DEFENSE-PALJOJARV

Co-Authors: Pedro MARTINS FERREIRA

Comparing supply and use tables (SUT) between two countries is only possible if they share a common classification of products and industries. Eurostat publish annually SUT at country level and consolidated EU and euro area levels, using the Common Product by Activity (CPA 2008) for products and NACE Rev 2 (in line with ISIC 4) for industries, with 64 products and 64 industries (64x64). Bureau of Economic Analysis (BEA) publishes annually SUT for the United States using North America Industry Classification System (NAICS), at 72 products and 71 industries (72x71). Since there isn't a direct correspondence between (NAICS) and (CPA/NACE) - sometimes there is a many-to-many correspondence - it is needed to breakdown US SUT at a more detailed level at which the correspondence to (CPA/NACE) can be made, while maintaining the needed balance between supply and use tables. This paper proposes a methodology to convert (NAICS) into (CPA/NACE) classification that operates in three stages: first, detailed US tables are used to expand the (72x71) level to (392x391) level of detail. In the second stage, a balancing procedure, specifically developed for this project, balances the (392x391) tables while maintaining the consistency between the detailed tables and the official (72x71) tables; finally, the SUT balanced estimates at (392x391) can then be aggregated to meet the European (64x64) tables at (CPA/NACE), which by construction are balanced. This method is a follow-up and development of previous methodology where the conversion from NAICS to CPA/NACE was done at aggregated level (64x64 CPA/NACE). The converted US SUT are comparable to EU SUT. The methodology proposed in this paper was used to convert US SUT to CPA/NACE from 1997-2015 and they are

available at Eurostat website.

Keywords: NAICS classification; CPA; NACE Rev. 2; correspondence table; balancing;

Evaluating the Impact of A Carbon Tax in Portugal Considering Alternative Assumptions for Price Elasticity of Demand

Topic: (2.7) Input-output analysis for policy making (1)

Author: Ana Maria Dias

In 2015 we presented a paper to the 23rd Input-Output Conference, Mexico City (paper no. 85 in the conference page) with the methodology and results for the evaluation of the macroeconomic, fiscal and environmental impact of the introduction of a carbon tax in Portugal, using a multi-sector macroeconomic model (MODEM 7) combined with an input-output (I-O) price model, considering different levels and scopes for this tax as well as alternative ways of recycling the additional corresponding public revenue. This evaluation was made considering an implicit assumption of zero price elasticity of demand shares (vertical technical coefficients), at constant prices, for intermediate consumption and for households' final demand. While this assumption may be considered acceptable for intermediate consumption (in the short-term), given a certain inertia in production technology response to price changes, it is more questionable for private consumption.

In this paper we present an alternative evaluation of the impact of the carbon tax for the Portuguese economy and environment, considering the assumption that price elasticity of households' real share of each product on total consumption is equal to -1. We describe the methodological changes made to consider this new assumption and compare the results with those obtained from the previous zero price elasticity assumption for private consumption. An improvement is also made and presented regarding the method for estimating the impact of the carbon tax on CO₂ emissions.

Both MODEM 7 and the I-O price model consider 85 homogenous industries and were calibrated using a system of symmetric I-O tables and other recent macroeconomic and environmental data available for Portugal, from official sources.

Ecological Network Analysis of Sectoral Energy Flows in the EU

Topic: (9.3) Energy Input-Output Modeling (3)

Author: Florian Dierickx

This paper focuses on recent advancements in the assessment of sectoral energy flows in the EU using input-output analysis and ecological network analysis, and focuses on the current and planned data-collection policies on regional and national level that enable future progress in this direction. More specifically, the paper first elaborates on the methodological compatibility of ecological models and energy input-output models and recent progress made in combining these methods, and focuses specifically on critical methodological issues evolving from whether the analysis is carried out from a monetary or physical perspective. Recent insights in the compatibility of these (Majeau-Bettez, 2016; Többen, 2017) are discussed in the context of energy flow assessment. Based on this methodological assessment, data needs and data availability are discussed and are linked with ongoing efforts in statistical institutes on different institutional levels, such as the recent evolutions in the development of physical energy flow accounts (PEFA) on European level (Vandille, 2015; Rachermacher, 2015). The paper contributes

to the debate on critical issues in carrying out monetary and physical input-output assessment for energy flows, recent advancements in ecological network analysis applied to input-output tables and links these debates with current institutional efforts and policies on national and regional level.

Towards a more effective climate policy on international trade

Topic: (3.6) Environmental IO modeling (3)

Author: Erik DIETZENBACHER

Co-Authors: Iñaki Arto, Ignacio CAZCARRO

In a recent contribution, Kander et al. (2015) rightfully state that “[A]ctions that contribute to reduced global emissions should be credited, and actions that increase them should be penalized.” Neither production-based accounting (PBA) nor consumption-based accounting (CBA) satisfies this principle. Kander et al. (2015) point out that one of the weaknesses of CBA is that it fails to credit countries for cleaning up their export industries. They propose technology-adjusted CBA (TCBA) to remedy this weakness. However, we show that also TCBA may penalize a country to engage in trade that reduces global emissions (albeit to a lesser extent than does CBA). The reason for this is that Kander et al. (2015) do not take full account of the second weakness of CBA they mention. Namely, “that CBA fails to encourage certain kinds of specialization and trade that might contribute to a more carbon efficient use of global production resources.” We argue that emission accounting is one thing, but developing a scheme for assigning responsibilities (or credits and penalties) is another. Based on classical Ricardian trade theory, we develop a scheme for emission responsibility allotments (ERAs).

The sectoral structure of an emergent economy in light of I-O analysis

Topic: (2.6) Input-output accounts and statistics (1)

Author: Emilian Dobrescu

Co-Authors: Viorel Nicolae Gaftea

“The sectoral structure of an emergent economy in light of I-O analysis”

Emilian Dobrescu and Viorel Gaftea - Romanian Academy, Center for Macroeconomic Modelling, Romania, Bucharest, 13, Calea 13 Septembrie

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1) The paper attempts to reveal the main structural changes (in sectoral profile) produced during the transition - study case: Romania.

2) As a leading method the I-O techniques are used, in Leontief model version.

3) There are involved information resulted from the I-O tables, homogenized as annual series for entire period 1989-2014. Extended classification of 88 branches was compacted into a fourteen sectors structure. Current prices were preponderantly used.

4. Contributions:
4.1. The paper explains, including analytically, the comprehensive significance of sectoral shares in GDP as an indicator of sectoral structure. It synthesizes both groups of factors influencing economic life - supply-sided and demand-sided.

4.2. Two measures of structural changes speed are involved: moving structural change coefficient (estimates intensity of adjustments produced between two successive years), and referential one (compares registered sectoral shares with a given fixed vector). Computing these

parameters, the paper concludes that Romania has registered, from this standpoint, three distinct phases:

a) Decade 1990-1999. Dominated especially by demolition - along with the centrally planned mechanism - of the main industries, transportation networks, large agrarian exploitations, educational system. At a macro-structural level this phase distinguished itself by a convulsive evolution.

b) Pre-accession to EU period, 2000-2006. Characterized by ceasing of the chaotic institutional changes and implementation of complex reforms based on the adopted Program for Integration and negotiations with European Commission. This phase induced a more stable sectoral structure.

c) Status as EU full member 2007-2014. Unfortunately, the official accession to the EU could not be integrally fructified because of the latest world crisis. Years 2009-2011 registered a slowdown and serious decline, followed by a modest recovery (2012-2014). The changes in sectoral structure intensified again.

4.3. The technical coefficients are used to reveal the intensity of inter-sectoral linkages. Over half of them belong to nonsignificant or very weak classes, and approximately a quarter to the moderate one. 22-23% of them are characterized by important inter-sectoral linkage intensity, being defined as nodal technical coefficients. The "cumulated direct effects", consisting in the row/column sums of A matrix are also analyzed.

4.4. The paper evaluates real-nominal discrepancies which can occur during economic changes. Relating to output, the sectoral structure was determined in three variants: a) current prices; b) previous year prices (in I-O applications these are usually labelled as constant); and c) base 1995 prices. Thus there were identified three groups of aggregated sectors. One (sectors 1, 4, 5, 7, 11) is characterized by a long-lasting relative nominal depreciation; another (sectors 2, 6, 8) displays an approximately convergent dynamics; the last category (sectors 3, 9, 10, 12, 13, 14) reunites the main "winners" of this sui-generis "real-nominal competition".

4.5. Overall, five patterns of sectoral dynamics were identified:

- The shares in GDP of sectors 1 (agriculture, forestry, hunting, fishing) and 5 (textiles, leather, pulp and paper, furniture) have been placed on a descending trajectory.

- The sectors 2 (mining and quarrying), 7 (other manufacturing industries), and 14 (professional services - mainly businesses) also knew initially a descending evolution but, during the last period, one of them (2) has shown some signs of stabilization, while the others - even an increasing trend.

- There are sectors which have begun the transition on an ascending trend, only to continue by a descending evolution. The sectors 9 (transports, post and telecommunications) and 10 (trading services) are in such a situation.

- Oscillating dynamics do not lack as well. In some cases it ends by stabilization: sectors 3 (production and distribution of electric and thermal power) and 6 (machinery and equipment, transport means, other metal products). In others, however, the last part of interval seems to be associated rather with a descending trend (sector 4 - food, beverages and tobacco) or, on the contrary, with an ascending one (sector 11 - financial services and real estate transactions).

- The clearly defined ascending dynamics was also present. This concerns sector 13 - creative services.

The tendencies revealed by other authors for transitional economies - mainly "de- and re-agrarization" (the latter as a temporary phenomenon), "deindustrialization", and "tertiarization" - are also visible in the I-O analysis.

A Dynamic Input-Output Model for Evaluating Strategies about Global Development and Sustainability

Topic: (2.5) Special Session: Modelling Sustainable Development: Revisiting Dynamic Input-Output Analysis

Author: Faye DUCHIN

A Dynamic Input-Output Model for Evaluating Strategies about Global Development and Sustainability

Faye Duchin

Abstract. The urgency of today's concerns to reduce both global inequality and environmental degradation, which will entail substantial public and private infrastructure and capital equipment, makes it timely to take on the development of an operational dynamic input-output model. We now have models of the world economy with closure for international trade and databases that complement input-output accounting data with both engineering data and quantification of resource endowments and flows. Existing empirical studies have analyzed a variety of alternative development scenarios, some using a modeling framework in which choices among alternative technologies are endogenous (Duchin and Levine 2011). Only a dynamic model can represent inter-temporal and inter-sectoral consistency throughout extended periods, with each technology characterized by the magnitude and composition of built capital requirements as well as by the kinds of pressures it places on resource use and on the environment.

This paper scopes out and begins to address several types of challenges in creating a dynamic model of the global economy. My starting point is the dynamic model developed by Duchin and Szyld (1985), first implemented to study the impacts of automation on workers in the U.S. (Leontief and Duchin 1986). This model represents a sector's capital stock by two well-defined measures, the maximum output it can provide (its capacity) and a vector representing its composition in terms of sectoral inputs required per unit of capacity output. The price dual must assure that incomes earned in the economy, including returns on capital, cover not only consumption costs but also the costs of putting the new built capital in place. Another consideration is that the mathematical conceptualization must be compatible with the linear programming framework of the choice-of-technology and the world trade models (WTM/RCOT) with which it will be integrated. Finally I describe the data requirements. These cannot be satisfied by existing databases, and I provide ideas for their compilation or estimation that go beyond the kinds of rough estimates made by Leontief and Duchin (1986) three decades ago. This paper describes a dynamic model for a single region with endogenous choice among alternative technologies, where each technology is characterized by both its intermediate and capital requirements.

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Reduction Potential Analysis of Life-cycle CO₂ emissions through the Market Expansion of Eco-friendly Vehicles

Topic: (6.2) Environmental IO modelling (4)

Author: Shogo EGUCHI

Co-Authors: Shunichi Hienuki

The expansion of automobile society has been one of the main causes of accelerating the global warming. According to International Energy Agency, the CO₂ emissions from the transportation sector accounts for 23% of the global CO₂ emissions in 2007 and transport CO₂ emissions are estimated to increase by more than 80% by 2050. For this background, eco-friendly vehicles such as Hybrid Vehicle (HV) and Plug-in Hybrid Electric Vehicle (PHEV) are expected to reduce CO₂ emission at driving phase due to their higher fuel efficiency. On the other hand, Kagawa et al. (2013) pointed out that, in manufacturing phase, the CO₂ emissions from these vehicles were larger than standard-size gasoline cars because these new technologies have a battery and more complex power distribution electronics than standard-size gasoline cars. When considering the CO₂ emissions at the manufacturing phase, introducing eco-friendly vehicles does not necessarily result in efficient reduction of life-cycle CO₂ emissions from automobile. To assess the reduction potential of life-cycle CO₂ emissions by the spread of eco-friendly vehicles, this study employed the Data Envelopment Analysis framework provided by Sueyoshi and Goto (2012) and assessed how efficiently the market expansion of eco-friendly vehicles would bring about the economic development and reduction in life-cycle CO₂ emissions simultaneously. We considered the number of newly registered gasoline vehicles, commercial vehicles, HV, PHEV, and EV in 40 countries from 2004 to 2014 provided by Marklines as inputs, economic scale of automobile market of these 40 countries estimated from the World Input-Output Database as desirable output, and life-cycle CO₂ emissions from these vehicles as undesirable output. The results showed the reduction potential of life-cycle CO₂ emissions from automobile through the spread of eco-friendly vehicles was considerably large especially in developing countries. This study argues the role of the vehicle policy in developing countries on global warming.

The economic impact of the 2016 Italian earthquakes with a Bi-regional IEMM approach

Topic: (4.2) Input-Output analysis of disasters

Author: Andrea K. EL MELIGI

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The Central Italy was faced with two strong earthquakes in August and October 2016 followed by other swarm earthquake events. The occurrence of these disruptive events has more recently create a new strand of literature in the topic of the disaster impacts analysis. This catastrophic events besides bringing devastation can cause economic blackouts to important activities inside the supply chain, perturbation able to produce different magnitude reaction in terms of economic performance, including effects on the social capital, the income and the learning (Yamamura, 2010). In the aftermath of these events the importance of an assessment "of the direct and indirect effects, and their consequences on the social well-being, is indispensable for identifying and undertaking reconstruction programme and projects"(Bradshaw, 2003).

In this field one of the most "beaten track" in studying and analyzing highly interconnected economic system is the Inoperability approach. The Inoperability Input-Output Model (IIM) has

been for the first time introduced theoretically in Haines and Jiang (2001), and from then on widely tackled

and discussed by Santos and Haines (2004) and Leung et al. (2007) with several assessment of disruptive events due to terrorism that cause inoperability across interdependent infrastructures. Further studies that represent an extension of the IIM approach has been recently introduced with the purpose to enlarge the spectrum of the results, including not only the direct and indirect effects, but also the induced effects. In fact the critical aspect of the IIM approach is therefore represented by the overall underestimation of the economic impact of the event due to a partial representation of the economic phenomenon.

In this respect the Inoperability Extended Multisectoral Model (IEMM) implements a bigger accounting scheme such as the Social Accounting Matrix (SAM) for assessing the effects of a system perturbation as in the case of the UK Air transport Services in the aftermath of the Iceland Volcano Eruption in 2010 (Ciaschini et al., 2016).

Along these lines the effort of this study is to present an evolution of the IIM and a further in-depth analysis of the IEMM approach, introducing a Bi-Regional IEMM (hereinafter referred to as B-IEMM) based on a Bi-Regional Social Accounting Matrix that divide the Italian territory in two macro-areas, North-Central and South-Islands. The results of this model provide an assessment of the higher order effects in the production processes and the impact in the disposable income of the institutional sectors affected in the aftermath of the two strong earthquakes occurred in August and October 2016 in the Central Italy.

The B-IEMM methodology is based on the Demand-Reduction IEMM, following the considerations of the demand-side IIM (Santos and Haines, (2004) and Haines et al., (2005)), and according with the reflections suggested by Dietzenbacher and Miller (2015). This methodology is developed as an inter-dependency analysis tool for assessing the ripple effects triggered by various sources of disruption such as natural disaster or human hazard (Ciaschini et al., 2016).

In order to achieve the task of an economic impact analysis it is of primary importance to introduce the starting framework. The use of SAM methodology in the disaster analysis studies has been largely tackled by Cole (1995, 1998, 2004), by Bradshaw (2003) and more recently by Okuyama and Sahin (2009) among others. In fact the SAM is an adaptable accounting scheme that presents inter-dependencies among activities, primary factors and Institutional sectors at different level, it is therefore able to detect an interdependent system failure and consequently supporting modeling in the task of measuring the inoperability due to a perturbation (Ciaschini et al., 2016). Moreover, this framework points out the disposable income formation process in order to assess not only the impact of intervention policies on the main economic variables (GDP, output, employment) but also to evaluate the income distribution variation among specific groups inside the institutional sectors at a deepen level.

As previously mentioned, this study is based on a Bi-Regional SAM (B-SAM) were a distinction between two macro-areas, North-Central and South-Islands, is provided. This scheme includes: six-teen industries per each macro-area, two components of the Value Added per each macro-area, Capital formation and Rest of the world. Moreover the framework presents further differentiation in the Institutional Sectors such as Households and Financial corporation and offers a detailed scheme that contains, per each macro-area, different level of Government: Central, Regional, Provincial and Municipal.

The B-SAM used exploits an already existing framework (Pretaroli and Socci, 2008) that has been updated with the 2012 data provided by the National Institute of Statistics (ISTAT).

Accessibility, Transportation Cost and Regional Growth: A Case Study for Egypt

Topic: (6.4) CGE Modelling (3)

Author: Dina N ELSHAHAWANY

The potential ability of transport infrastructure investments to produce transport benefits depends on the travel time reductions and accessibility. In this paper, we use an interregional computable general equilibrium (CGE) model to estimate the economic impacts of transportation cost change due specifically to changes in accessibility induced by new transportation projects. The model is integrated with a stylized geo-coded transportation network model to help quantify the spatial effects of transportation cost change. The analysis is focus on a proposed development corridor in Egypt. A main component of the project is a desert-based expansion of the current highway network. The paper focuses on the likely structural economic impacts that such a large investment in transportation could enable through a series of simulations. It is clear that an integrated spatial CGE model can be useful in estimating the potential economic impacts of transportation projects in Egypt. In this vein, this or similar models should support government decisions on such projects.

Modeling and Assessing Income, Labor and CO2 Emissions Multipliers from Different Biorefinery Technological Routes in Brazil.

Topic: (8.5) Impact Analysis: Multipliers (2)

Author: Romulo N. Ely

Abstract: We have evaluated a range of biorefinery technological routes based on sugarcane bagasse, through estimating their income, labor and emissions (CO₂) multipliers in Brazil. By treating this range of novel technologies as new industries, we have built and compared different scenarios through an environmental and socioeconomic perspective – changes in emissions, labor and income due to the insertion of each one of these new economic activities into the Brazilian economy. We have used a hybrid (energy commodities in physical units and non-energy commodities in monetary units) input-output database, into which, basically a set of technological routes family were introduced: integrated gasification combined cycle (IGCC), Biomass to Liquids (BTL) and Hydrolysis. The process analyses of these technological routes are mainly based on Santos et al. (2016) – as well as their respective production recipe and minimum selling prices. These industrial plants are capable to convert the lignocellulosic material (sugarcane bagasse) to: ethanol, electricity, DME, diesel, gasoline, higher alcohols, and succinic acid (a bio-chemical platform). Even though many products can be obtained from these novel technologies, this study considered only a subset that represents products currently traded in the Brazilian market. All of these biorefinery types have not reached the commercial scale yet. Therefore, this approach can support policy makers and R&D funds (such as the one derived from Brazil's petroleum production) to identify biorefinery technological routes worth investing, according to their estimated environmental and socioeconomic effects.

Paving a Path toward Sustainable Energy Security: Examining a Global Transition toward Ethanol Production.

Topic: (7.5) Input-output analysis for policy making (3)

Author: Romulo N. Ely

Co-Authors: Nasim Fathi, Michael L LAHR

Brazil has made strong efforts in terms of public policies for stimulating the ethanol production based on sugarcane and has achieved considerable results on this matter. Sugarcane-based technology for producing first generation ethanol is in the mature stage of development in the country, which is the world largest supplier of ethanol production from sugarcane. In Brazil, ethanol is supplied at competitive prices and, from a perspective of carbon footprints, provides benefits compared to gasoline. In this vein, other sugarcane-producing countries might join the ethanol bandwagon. Indeed, prime candidates are Australia, China, Colombia, India, Indonesia, Mexico, Pakistan, Philippines, Thailand and the United States of America. This study evaluates the potential economic consequences of growing this nascent industry using an input-output approach. We examine its potential by configuring a new biofuel industry by borrowing information from the existing large-scale alcohol industry in Brazil and adjusting for possible productivity differentials. Brazil's data are based on an IO-LCA (input-output life cycle assessment) approach. We augment the industry's sales following a hypothetical hydrous and anhydrous ethanol consumption scenario. We thereafter reconcile the national accounts. We conclude the analysis by quantifying and comparing the different net effects of this new industry for each of the assessed countries: in the terms of GDP, labor compensation, and employment, as well as its net effects on each nation's oil imports avoided and worldwide CO₂ produced.

An Analysis on the Evolution of Industrial Restructuring and the Factors Affecting the Quality of Development in China's Yangtze River Delta Region

Topic: (2.3) Structural Change and Dynamics (1)

Author: Jin FAN

Co-Authors: Cheng LUO, Xiaohui YUAN

The Yangtze River Delta of China is listed as one of the six biggest urban agglomeration in the world, which includes Jiangsu province, Zhejiang province, and Shanghai metropolis. It has been becoming more and more important leading area in Chinese beautiful economic performance. Therefore, there exists great realistic significance and theoretical value to explore the region's industrial transformation and upgrading process, and the factors affecting the quality of development. This paper uses input-output coefficient changes of industrial structure transformation, and the error between the actual and gold value added rate to show the quality of economic development and the influence factors of the Yangtze River Delta region. By comparing the Chinese Yangtze River Delta region of Jiangsu province, Zhejiang province, Shanghai metropolis in 1997 and 2012 input-output table, the comparison and analysis of the change from 1997 to 2012 during the period of technological progress and industrial structure impacts on the Yangtze River Delta region. The results show that: Firstly, economic development is still dominated by the secondary industry in Yangtze River Delta region. However, as the central of the region, Shanghai's service function has gradually become prominent. Secondly, the joint action of technological progress and economic structure changes makes the Yangtze River Delta region to reduce its intermediate demand on the primary industry, and to increase on the secondary industry, but on the tertiary industry, Jiangsu province and Zhejiang province is

reduced, and Shanghai metropolis on the contrary. Thirdly, although the fact that technical factors and changes in the industrial structure have negative influences on the comprehensive effect of the Yangtze River Delta region, Structural changement has more impact on Jiangsu province than that of technological progress, while has less impact on Zhejiang province than that of technical factors. However, the factors of technology and the change of industrial structure did not contribute to the reduction of the consumption level of Shanghai economy. Fourthly, on the point of view of the manufacturing industry, and Jiangsu province and Zhejiang province have competitive advantages on heavy industry at the same time. Jiangsu province pays more attention to the development of high-tech industry, and Zhejiang province will pay more attention to the development of light industry, and the development of Shanghai manufacturing industry is within knowledge intensive manufacturing advantages. Finally, technological progress does not play a role in the secondary sector of the Yangtze River Delta region, but the upgrading of the industrial structure has improved the Zhejiang and Shanghai economy by changing the intermediate demand on the secondary industry. Based on the index raised by Fan et al [2016, 2017a] and Jiang et al [2017b] which reflects the economic growth quality by the deviation change rate that is calculated by using the actual value added rate and golden value added rate, and through the establishment of GMM panel data model, the paper has drawn the following conclusions: Firstly, the development of the overall quality of the Yangtze River Delta region has been showing a trend of increase gradually, and Shanghai metropolis is more pronounced, and while Jiangsu province and Zhejiang province have relatively stable performance. Secondly, changes in the quality of economic development level of the Yangtze River Delta region are related to the population policy, the financial policy and industrial policy. Thirdly, the quality of economic development in the Yangtze River Delta region is directly related to the level of innovation accumulation, R&D investment, human capital investment in science and technology, export have a positive impact on improving the quality of development, and while the proportion of state-owned economy to improve the quality of development has positively affects the improvement of quality of development and other policies without being influenced by other policies, which is not the same as the existing mainstream research. Finally, it is more obvious that the population policy improves the development of the Yangtze River Delta region quality, such as improving the city rate, increasing education. Among them, the existing HUKOU registration system, the Family Planning policy significantly enhances the quality of economic growth, which should be paid much more attention to by the policy-makers.

Testing the PHH in a Resource-cursed Country: The Case of Iran. An Input-Output Analysis.

Topic: (3.6) Environmental IO modeling (3)

Author: Nasim Fathi

Testing the PHH in a Resource-cursed Country: The Case of Iran. An Input-Output Analysis.

Nasim Fathi *

International trade promotes economic growth and development. And economic growth is associated with energy use, which contributes to environmental degradation. So in essence free trade compromises environmental quality but favors distributional income improvements and economic prosperity. Iran is the world's ninth largest emitter of CO₂ according to a 2016 report by the International Energy Agency. An investigation into a CO₂ emission, as embodied in Iran's imports and exports is likely worthwhile. This paper aims at contributing to environment trade debate by evaluating the impacts of international trade on emissions of co₂ (Carbon Dioxide), we

have used an index of pollution terms of trade.

We examined changes in Iran's emissions of CO₂ as embodied in trade using Iran's (industry by industry) input-output accounts for 2006-2007 and 2011-2012. I thus examine whether Iran's economy leans toward being a pollution haven, an economy that has a particular set of factor endowments like oil production, neither, or both. This paper challenged the compatibility between environmental and international trade policies. Results show that the indices are below 100, indicating that Iran produced goods that are more environment friendly than goods it imports, thus challenging the pollution haven hypothesis for Iran.

Key words: International trade, environment, pollution haven, IO Analysis.

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A new sub-national multi-region input-output database for Indonesia

Topic: (7.4) Special Session: Virtual Laboratories: Wrapping up Project Réunion and the Industrial Ecology Lab development

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As a large archipelago with significant geographical variation and economic diversity, Indonesia requires detailed regional information when subjected to economic modelling. Whilst such information is available, it however has not been integrated and harmonised into a comprehensive input-output database, thus preventing economic, social and environmental modelling for investigating sub-national regional policy questions. We present the new IndoLab, a collaborative research platform for Indonesia, enabling input-output modelling of economic, social and environmental activities in a cloud-computing environment. Within the IndoLab researchers are for the first time able to generate a time series of regionally and sectorally detailed and comprehensive, sub-national multi-region input-output (MRIO) tables for Indonesia. By integrating a multitude of economic, social and environmental data into a single standardised processing pipeline and harmonised data repository, the IndoLab is able to generate MRIO tables capturing up to 1,148 sectors and 495 cities and regencies. Researchers can freely choose from this detail to construct tables with customised classifications that suit their own research questions. A first test run of the IndoLab clearly demonstrates the unique characteristics of regions in terms of their sectors' employment intensity. Thus, the IndoLab has great potential for investigating policy questions that cannot be comprehensively addressed using a single national database.

Embodied Freight Transportation in US Goods and Services, 2007-2012

Topic: (5.4) Industrial Ecology using IO Tables

Author: Da Fei

Demand for freight transportation is accelerating with the globalization of increasingly fragmented production processes. In the meantime, the energy usage and environmental emissions of freight grow rapidly. As the awareness of environmental issues grows, it is necessary to transport goods and services in a more efficient and green way. However, when shippers choose freight transportation, they value time and cost rather than its related energy usage and

environmental impacts.

This paper brings the analysis of estimating the share of embodied freight transportation for each industry in the U.S. from 2007 to 2012. I use U.S. Bureau of Economic Analysis Input-Output tables, and Commodity Flow Survey Data from U.S. Bureau of Transportation Statistics. In the analysis, identifying the shippers of these freights can be challenging. Allocating the freight transportation to the industry level enables the analysis to perform such task. Moreover, freight movements are embodied in upstream supply chains. I track both direct and indirect transportation needs of each industry using input-output analysis.

This research extends the resulting analysis of Nealer et al.'s (2011) by including more recent data. Thereby, I can perform the trend analysis of freight transportation at industry level. I also estimate energy usage and environmental emissions of freight to inform policies for reducing the environmental impacts of freight. Since freight transportation is induced demand, analyzing modal freight transportation demand of different industries can inform mitigation strategies tailored to industries.

Multi Type Dynamic Input-Output System And Lorentz Transformation

Topic: (9.2) Dynamic IO Modeling and Analyses of Capital Formation

Author: GUANGMING FENG

Multi Type Dynamic Input-Output System And Lorentz Transformation

□Abstract□

Introduction

It is well known that we can repeatedly solve the inverse matrix, which is to mean that we can repeatedly use of the parallelogram law of diagonal on the coordinate geometry in order to obtain Leontief line.

First, there is enlightenment significance, when I solved the Nonlinear Model of the Dynamic Input-Output System (NMGDIOS) and obtained its optimal solution within Pontryagin maximum, with my paper entitled as "The Generalized Dynamic Input-Output Principle" for the 24th International Input-Output Conference, Seoul, Korea 2016, that Leontief line and the optimal solution had great consistency. It was not difficult to be found, while I compared them.

This shows that Leontief line and the optimal solution in Pontryagin maximum could be defined as the extreme limit of the input-output for the whole society; which it is like as "the world line" in the Relativity.

Second, with a view to facilitating research, I can choose that a country exist only two types of the Linear Dynamic Input-Output System (LDIOS), as the starting point of my research. In which sectors of two types are changing, in material structure and in value component, of the ebb and flow with each other.

Third, this is surely right in mathematics that the present theory usually take Perron-Froubenius root for the corresponding solution for the multi-type\sector of LDIOS. But, as the evolution of the multi-type\sector of LDIOS, if combined with their changing of the ebb and flow with each other in material structure and in value component, I could have a deeper understanding to Perron-Froubenius root.

Fourth, How to show the existence and the transformation process of the LDIOS or NMGDIOS among different types in the geometry space or in multidimensional space? I have been puzzled for a long period of time.

While I respectively correspond to its extreme line one by one, according to the changes in material structure and in value component of LDIOS or NMGDIOS among different types, I see that the extreme line appear to change constantly with its rotation present a counterclockwise and its angle become bigger and bigger on Cartesian coordinate, as the sunlight left its trajectory on a corona, so as to complete one Lorentz transformation by one.

Fifth, on the premise of a number of assumptions, that pay attention to the scope of the intermediate consumption matrix A and of the investment matrix B, and whether meet the nonsingular matrix that satisfy as derivative, reversible, measurable nonnegative matrix, on the basis of building Jacobian matrix, as a work out its corresponding matrix with NMDIOS.

Then by solving the corresponding characteristic equation of the Jacobian matrix, as NMDIOS extremum area on its curved surface, in which it could be obtained the optimal linear approximation value in its extremum point. If the equation is a nonsingular matrix, the Jacobian matrix can be solved. As a result, there is a group of its characteristic roots which can be obtained an optimal linear approximation value at the extreme point on its curved surface as approximating to NMDIOS, thus obtaining the optimal solution of Pontryagin maximum for NMDIOS1 and NMDIOS2 respectively, thus obtaining base solution matrix with its special solution, as its equilibriums of NMDIOS1 and of NMDIOS2 respectively.

In which I can be on the deductive analysis: 1) That is to expand NMDIOS from two types to multi-type of coexisting; 2) The constitute of the corresponding Jacobian matrix with NMDIOS, which can be extended to multiple optimization variables; 3) Based on its equilibrium solutions of NMDIOS1 and of NMDIOS2, which it can be extended a series of solutions containing the particular solution to the n system.

Final, as the optimal solution corresponds to the multi-type of NMDIOS, it can be drawn the corresponding curve of asymptote. Combined with the above extremum line, it can be realized the Lorentz transformation with the optimal solution, as the space of the phase diagram for the multi-type of NMDIOS.

Carbon inequality of in the U.S.

Topic: (2.2) Environmental IO Modelling (2)

Author: Kuishuang Feng

Co-Authors: Klaus HUBACEK

Consumption-based CO₂ emissions have been highlighted as an important indicator for global climate change mitigation in the past decade. Household consumption and associated CO₂ emissions for different income groups in the US vary significantly which leads to the critical discussion on environmental and income inequality. By linking the US consumer expenditure survey data with multi-regional input-output analysis, this study is to estimate the consumption-based CO₂ emissions for 13 US income groups and assess the carbon inequality in the US. Our results show that carbon intensities of different consumption categories varies significantly and with increased income spending additional income on less carbon intensive services, which may help to prevent a fast growth of household carbon footprint. However, per capita carbon footprint of rich household is more than 5 times of the footprint of poor household. Our result highlight that the rich households in the US have much larger potential contribution to

US emissions mitigation through changing their consumption behaviors.

The Challenge of Estimating the Impact of Disasters: many approaches, many limitations and a compromise

Topic: (5.1) Special Session: Disaster Impact Analysis

Author: Andre Fernandes Tomon Avelino

Co-Authors: Geoffrey J.D. HEWINGS

The recent upward trend in the direct costs of natural disasters is a reflection of both an increase in asset densities and the concentration of economic activities in hazard-prone areas. Although losses in physical infrastructure and lifelines are usually spatially concentrated in a few areas, their effects tend to spread geographically and temporally due to production chains and the timing and length of disruptions. Since the 1980's, several techniques have been proposed to model higher-order economic impacts of disruptive events, most of which are based on the input-output framework. However, there is still no consensus for a preferred model to adopt. Available models tend to focus on just one side of the market or have theoretical flaws when incorporating both sides. In this paper, the Generalized Dynamic Input-Output framework (GDIO) is presented and its theoretical basis derived. It encompasses the virtues of intertemporal dynamic models with the explicit intratemporal modeling of production and market clearing, thus allowing supply and demand constraints to be simultaneously analyzed. Final demand is endogenized to study the impact of displacement and unemployment post-disaster. The key roles of inventories, primary inputs, labor force and physical assets in disaster assessment are explored and previous limitations in the literature are addressed. I show that the dynamic Leontief model, the sequential interindustry model and the traditional input-output model are all special cases of the GDIO framework.

Revisiting the Temporal Leontief Inverse: new insights on regional structural change

Topic: (7.6) Special Session: Disaggregation techniques for IO modelling

Author: Andre Fernandes Tomon Avelino

Co-Authors: Andre CARRASCAL, Alberto Franco Solís

The current availability of longer series of national/regional input-output tables, as well as the release of global input-output databases, has led to a growing body of the literature analyzing changes in the economic structure and their drivers. The most common technique applied is the structural decomposition analysis (SDA), which comprises of a comparative statics exercise between two periods. Given SDA's static nature, however, we cannot extract the evolution of industrial linkages from a time-series of annual input-output tables to understand the source of these changes. In response to such limitation, Sonis and Hewings (1998) proposed an alternative methodology denoted the Temporal Leontief Inverse (TLI). Different from a traditional SDA, the TLI focuses on industrial linkages only, but offers a dynamic framework to analyze their change. It allows tracing the evolutionary path of an industry's multiplier and the contribution of the rest of the economy to it through the temporal changes in the fields of influence. However, Sonis and Hewings' formulation only accounted for the simultaneous change in the whole economy from period to period. Hence, one could not isolate the contribution of a particular sector (or set thereof) to this evolutionary path to more precisely understand the underlying sources of its variation. In this paper, we modify the original formulation and devise a linear decomposition of

the annual change to address the latter. In a single region setting, we can isolate the contribution of structural changes in direct input requirements by sectors or group of sectors. In a multiregional setting, we can study the contribution of trade, foreign countries and technology to a particular sector. We illustrate the methodology by uncovering some hidden effects not captured in the application of the original TIL to Chicago done by Okuyama et al. (2006).

Sectoral disaggregation of input-output tables by entropy econometrics: is small (and medium) that beautiful?

Topic: (7.6) Special Session: Disaggregation techniques for IO modelling

Author: Esteban FERNANDEZ-VAZQUEZ

Small and Medium Enterprises (SMEs) are expected to present larger interconnections with other companies, given their usually higher level of territorial integration and stronger linkages with suppliers and customers. However, this hypothesis cannot be directly tested basing on usual input-output (IO) tables compiled by statistical agencies, because IO tables do not provide information about the size of the companies in each industry. This is only an example of the more general situation where the information contained in the IO tables is not detailed enough to give an answer to our research questions. To deal with problems like this, the literature has proposed several disaggregation techniques, since the original work by Wolsky (1984) to the more recent proposals by Lindner et al. (2012, 2013). This paper proposes a flexible disaggregation technique based on entropy econometrics that (i) uses as exogenous information all the data available on the sector(s) to be disaggregated, and (ii) allows making statistical inference on the results produced. Its use is illustrated by disaggregating industries belonging to the branch of commercial services in the Spanish IO table (2010) into small, medium and large companies.

Building Bridges: Conciliating Consumer Surveys and IO Tables with Minimal Information

Topic: (9.1) Special Session: Income Distribution in IO Models: Miyazawa Revisited (2)

Author: Esteban FERNANDEZ-VAZQUEZ

Co-Authors: Mònica SERRANO

The combination of consumption data from household surveys with the information contained in IO tables is a crucial step to conduct impact analysis related to the effects generated by consumption patterns on the generation of value added, CO2 emissions or energy uses, to mention just some examples. The point of departure of these analyses consist, basically, on connecting the information on consumption made by households with the final demand vector (or matrix) present in the IO tables, which is then conveniently modified to produce the multipliers of interest. This process requires the construction of a concordance or bridge matrix to make this connection possible, since several issues affect the combination of these two data sources: differences in price valuation between consumption surveys and IO tables, the influence of taxes and margins or the different product classifications between these two frameworks make this combination a challenge for the researcher.

In this paper we explore this challenge with a twofold purpose: (i) to investigate how important a “good” or “bad” conciliation of our consumption data between household surveys and IO tables affect our results in terms of impact analysis; and (ii) to propose a conciliation technique between both data structure, which using only minimal information provides a systematic way or

reconciling them if detailed data are not at hand. This technique is based on entropy econometrics and it allows making statistical inference on the bridge matrix estimated. Both research objectives are illustrated by means of numerical simulation and by its application to real-world cases.

A value chain analysis of Port Wine production

Topic: (7.7) Region/country-specific analysis (3)

Author: Joao Pedro FERREIRA

Co-Authors: Eduardo Barata, Luís Cruz, Pedro N. RAMOS

Port wine is one of the most emblematic Portuguese products. It is mainly destined to external markets, exports representing 82% of total sales. The specific production of Port wine must include grapes exclusively harvested in vineyards located in the interior North of Portugal - a region that broadly corresponds to the NUTS III "Douro". In the 18th century, when its internationalization begun, a significant part of the productive process was allocated to near the Oporto city - NUTS III "Greater Oporto" - where the wine was stored and aged in barrels located in cellars. Recent legislation, combined with the increasing incorporation of services inputs and modern technologies, has increased the complexity of this product value chain.

This work aims to detail the Port wine production value chain in the context of the Portuguese economy. A Multi Regional Input-Output model, considering three regions - Douro, Greater Oporto and the Rest of the Country - is used in the estimation process. Moreover, this model benefits from the independent disaggregation of six different wine products, as well as other relevant inputs used in the production of Port wine. The model also distinguishes the production technologies of "Ordinary and Sparkling Wine" and "Liquor Wine" industries. The derived framework is based on a 'rectangular' Supply and Use table for 2010.

The preliminary results show that in spite of being mainly an exported product, Port wine also has a high incorporation of imported inputs (25.1% of the total national value; 9.7% are imports of the Port wine industry itself, including glass bottles, distilled alcoholic products, barrels and others). In regional terms, this work concludes by an important concentration of the value chain in the region where the product is stored, aged and then sold, though the contribution of the Rest of the Country region is also important.

Labour Productivity in Vertically Integrated Sectors: An Empirical Study for the Case of Brazil

Topic: (8.1) Productivity and efficiency analysis

Author: José Bruno Fevereiro

Co-Authors: FABIO NEVES PERACIO DE FREITAS

This article proposes an analysis of the evolution of labour productivity in the perspective of vertically integrated sectors (VIS), based on the framework originally proposed by Pasinetti (1973). The paper argues that the analysis of labour productivity in terms of VIS avoids capturing, as increased productivity, effects arising from mere outsourcing of activities, as is the case of the direct labour productivity measure (physical output per worker), or change in relative price, as it happens with the apparent labour productivity measure (value added per worker). Thus, in order to access the evolution of the competitiveness of the Brazilian economy since the turn of the century, the work then makes an application of the proposed methodology for the Brazil

analysing the performance of the VIS and contrasting the results obtained with the traditional measures. The study makes use of input-output matrix recently released by Brazil's national statistics office for the year 2010 and coherent supply and use tables until 2014. This research aims to contribute to existing literature regarding productivity analysis in VIS framework, providing evidence for a developing country such as Brazil. Overall, the results shows a better performance of labour productivity of the VIS associated with final goods in the manufacturing industry vis-à-vis the measure of direct labour productivity of the activities of the manufacturing industry. These results indicate that significant productivity gains occurred in suppliers activities of intermediate inputs used in the production of manufacturing final goods.

Labour digital skills among Industries: a Macro Multipliers analysis

Topic: (7.2) Employment Analysis

Author: Elisa Foresi

Co-Authors: Maurizio CIASCHINI, Rosita PRETAROLI

1) The research question.

"Digital competence" is defined as a combination of knowledge, skills and attitudes appropriate to a digital context where a confident and critical use of information Society technology (IST) is needed for work, leisure, learning and communication" (European Commission, 2006). According to this definition, around 40% of the European Union population have an insufficient level of digital skills, of which 22% have none at all. Furthermore, schools and education systems are not yet ready to realise technology's potential (OECD, 2016) though the potential of digital technologies in order to produce a transformation of education (Colby et al., 2014). A huge significant policy effort, systemic reforms in education and training and investments in human capital will be required in order to achieve the skills challenges (European Commission, 2016). In this respect, the European Commission's 2010 Digital Agenda for Europe devoted a whole pillar to enhance digital skills, literacy and inclusion. In particular, the development of individuals' digital skills has received much attention as a remedy for digital inequality (Matzat and Sadowski, 2012). The Digital Agenda for Europe implemented several investment frameworks to address digital equality and to help employees to identify their digital gap supporting them for a life transition (Leahy and Wilson, 2014).

Up to now, the measurement of skills of labour force remains highly problematic (Martinaitis, 2014). For this reason the OECD has developed a comprehensive Skills Strategy that helps countries to identify the strengths and weaknesses of their national skills systems, to benchmark them internationally, and to develop policies that can transform better skills into better jobs, economic growth and social inclusion (Directorate for Science and Innovation, 2016). This paper would analyse the better policies for those Industries that uses digital skills labour.

2) The method used.

The paper develops a multisectoral analysis of the labour digital skills among Industries through the Macro Multiplier approach. We build the Social Accounting Matrix (SAM) for Italy in which the labour is divided in terms of "formal", "non formal" and "informal" competence and in addition into "digital skills" and "no digital skills". Labour digital skills are defined according to the "formal competence" declared by the European Commission: "formal competence" depends on level of education and training. With this respect, "non formal" competence is gained in the workplace and through the activities of civil society organisations and groups, while "informal" competence is acquired during the life without the intentionality (European Commission, 2000). Within this delineation, the paper introduces a further classification of labour based on the time use of computer and computer with internet connection. Than the paper develops a extended multisectoral model (Ciaschini and Socci, 2003), implemented on the Italian SAM in order to

identify the convenient endogenous policies much more oriented to those industries showing the highest utilization of digital skills labour.

3) The Data used.

In this paper we used the National Accounts data base (ISTAT, 2016), data on employment by industry and formal competence and digital skills data using the classification based on “digital economy and society” (ISTAT, 2016).

These data are compiled according to the 2008 SNA. The statistics in section “digital economy and society” describes the employees with formal and non formal competence based on the usage of computer and computer with Internet connection during the work. These data are in line with the Programme for the International Assessment of Adult Competencies (PIAAC) data.

4) The novelty of the research.

The contribution of this paper to the literacy consists of the disaggregation of labour in a multisectoral framework, SAM and multisectoral model, according the official definition of competence, following the OECD statistical of Information and Communications Technologies (ICT).

Growing green: The role of the Emissions Trading System on the dynamics of CO2 efficiency in Europe

Topic: (6.6) Structural change and dynamics (2)

Author: Alberto Franco Solís

Co-Authors: Andre CARRASCAL, Andre Fernandes Tomon Avelino

Since Leontief and Ford’s (1971) work on energy use, structural decomposition analysis (SDA) has been the main methodology in input-output to assess the evolution and role of economic variables in environmental issues. However, a major drawback of the latter is its pairwise comparison of steady-states instead of their dynamics through time. The temporal Leontief inverse (TLI) introduced by Sonis and Hewings (1998) solves this issue by accounting for the structural economic changes observed within the given time interval and their contribution to the current steady-state. Based on a time-series of input-output tables, the TLI embeds discrete time changes in the local economy into an adjustment process of the initial Leontief Inverse. We can then trace the evolution path of change identifying each year’s effect in what can be considered a temporal decomposition of change. By combining this technique with hybrid environmental input-output models, we can derive insights about the role of the structural change and the dynamics of production technologies in the generation of environmental externalities. As a result, in this paper we develop a hybrid temporal Leontief inverse model for assessing the process of structural change on greenhouse gases CO2 emissions that has occurred in the EU during the time period 1995-2009. Exploiting the information available at the World Input-Output Database (WIOD), we evaluate and compare trends before and after the introduction of the Emissions Trading System (ETS), and also the role of modern production chains in displacing environmental footprints.

Relative Advantage Production Position in Global Value Chain and its Applications

Topic: (8.8) Global Value Chain and Vertical Specialization (2)

Author: Xiang Gao

This paper defines a new indicator named “relative advantage production position” (also referred to as RAPP) to clarify the heterogeneity in global value chain between economies. Also, it puts forward an approximation algorithm to calculate RAPP on the basis of Input-Output model and Layer Lemma. Furthermore, this paper provides some properties of RAPP: there is a positive correlation between the sector’s RAPP and its upstreamness; and the non-uniqueness of RAPP is rooted in the characteristics of certain sectors, etc.

In empirical parts, this paper calculates the RAPPs of each sector based on China’s non-competitive Input-Output Table of years 2007 and 2012, and 2012 US non-competitive Input-Output Table. The results verify the positive correlation between the sector’s RAPP and its upstreamness, and also reveal some direct upstream relationship between sectors, especially between the sectors with single-purposed products. Meanwhile, this paper uses the 2007 and 2014 WIOD world Input-Output Table to measure each sector’s RAPP in different economies. The statistic results confirm that the non-uniqueness of RAPP is rooted in the characteristic of the certain sectors. Furthermore, the comparisons of RAPPs both in economy dimension and time dimension help us to find out the positional differences and positional changes in global value chain.

Compared with other indicators which embody a certain sector’s or economy’s role in the international labor-division, the RAPP contains the certain positional information in global value chain like Antras’s measurement of industry upstreamness. But when it comes to the positional differences in global value chain between countries/regions, the RAPP is able to reveal more notable heterogeneity in terms of the positions in global value chain across different economy. Meanwhile, the non-uniqueness of RAPP can indicate the multiple characters a sector play in the chain of production.

Methodological Proposal for the Estimation of Regional Technical Coefficients for the Construction of Regional Input Output Matrix, with a Bottom-up Approach.

Topic: (10.7) Regional input-output modeling (2)

Author: Karina GARDUÑO

Co-Authors: Normand E ASUAD, Roberto Ramirez Hernandez, Cristina VAZQUEZ

The importance of developing regional input-output matrices through a bottom-up approach rests on the analysis of interdependencies at the inter- and intra-regional levels. The construction of regional product input matrices, with the bottom-up approach, presents problems associated with the economic information available locally. Direct methods (survey) imply high costs in monetary terms and processing time. Therefore, the creation of regional accounts, using the bottom-up approach, aims to use the information available at the local level, except in cases where data are practically non-existent, where estimates can be made from information built from below.

The construction of input-output matrices requires the estimation of regional technical coefficients, since these differ from the national technical coefficients. The technical coefficients consist of an internal production component and an import component, the latter given by the import coefficients. In this way, regional import coefficients are also different due to the degree of productive specialization of each region and their capacity to generate exportable surplus, as well

as the degree of interregional interaction.

National coefficients fail to capture regional productivities, as they do not consider the spatial focus of the economy. From the bottom-up approach, the calculation of regional technical coefficients, requires the calculation of regional import coefficients. Therefore, the question guiding the research is: What can be the procedure for the calculation of regional technical coefficients? In order to answer, the following methodology is proposed: 1. Identification of the functional areas of the study region (subregions); 2. Construction of a system of regional accounts for the area of study; 3. Estimation of regional technical coefficients and regional import coefficients, taking as reference the economic base model, with an adjustment for local estimation, by identifying the economic activities and their productivities in each of the subregions of study. As an application case, the area corresponding to the Metropolitan Zone of Mexico City is considered, using economic census data.

The research constitutes an exploratory analysis, where a review will be done on the techniques used for the construction of regional coefficients. In this way, the novelty of this research goes in two senses: the first one is that it represents a methodological contribution in the construction of the regional technical coefficients and regional import coefficients, thus constituting, one of the main steps in the construction of regional input-output matrices, from a bottom-up approach; and the second is that it represents a form of application of the metropolitan model.

Productivity Change in an Input-output Economy: Colombia 2005 and 2011

Topic: (8.1) Productivity and efficiency analysis

Author: Enrique GILLES

Co-Authors: Javier Deaza

Productivity is at the core of economic growth and competitiveness. All major multilateral institutions related to economic development have a productivity agenda, especially directed to developing countries. Measuring productivity and identifying its main causes is therefore necessary. In this paper, we estimate productivity change for the Colombian economy at the sectorial level, from 2005 to 2011, and we infer the inputs or outputs which contribute most to that change. We include imports as a primary factor, as well as labor and capital. Imports may be a key explanatory variable for a small open economy like Colombia and can provide interesting facts about the country role in global value chains. Further, the estimated change in productivity is decomposed into efficiency change (distance to the frontier) and technical change (frontier improvements). We base our analysis on Luptacik y Mahlberg (2016), which integrate the Data Envelopment Analysis model and the Leontief input-output model to shed light on these productivity issues at the sectorial level. We extend their analysis by using the Luenberger-Hicks-Moorsteen productivity indicator (Briec and Kerstens, 2004) to estimate Total Factor Productivity growth. This approach does not require the assumption of perfectly competitive factor markets or data on input shares or on prices. By identifying which commodities and primary factors are the main drivers or bottlenecks to productivity growth, we expect to improve policymaking in Colombia.

Global Value Chains and Production Fragmentation: A Feedback Loop Analysis Based on ICIO 2016 Database

Topic: (3.4) Special Session: Understanding the Most Recent Evolution of Global Value Chains: New Approaches Based on New Databases

Author: Joaquim J.M. GUILHOTO

Co-Authors: Norihiko YAMANO

The underlying geographical structure of global value chains is the main object of study in this paper. The objective is to elucidate the spatial production structure 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. This application takes into account value-added flows involved in the supply chains, rather than interregional gross trade. The paper first presents a background perspective on how the fragmentation of production processes has led to the reorganization of economic activities around the globe and within countries. Then, the hierarchical feedback loop methodology is applied using the new OECD's ICIO 2016 database which takes into consideration 64 world regions (63 countries and the rest of the world) and 34 sectors, allowing in this way a macro level analysis, at the global level, of the spatial structure of the flows linking major economies across trade blocks. Therefore, the results allow a better understanding of how the production fragmentation takes place in the world.

The Asia Pacific Economic Cooperation Trade in Value Added Project

Topic: (10.2) Special Session: The Current State & Future plans of Global MRIO databases (2)

Author: Jiemin GUO

Co-Authors: William M Powers, Erich H STRASSNER

The Asia Pacific Economic Cooperation (APEC) Trade in Value Added (TiVA) project was initiated by APEC leaders in 2014 to enable more accurate global value chain (GVC) analysis and to measure APEC member economy engagement in GVCs. The APEC TiVA project's objective is to deliver a database for APEC economies by 2018 that can eventually be migrated in the OECD-WTO database. This paper overviews the potential benefits of the APEC TiVA project as it relates to other GVC initiatives, outlines the work plan and business processes agreed to for completing the project, and overviews broad methodological steps and decision points to meet the overall APEC objective.

Estimating Time-series SUTs for the United States

Topic: (9.4) Special Session: From USA national Supply, Use and Input-Output compilation to European standards

Author: Jiemin GUO

Co-Authors: Thomas F Howells

In the United States, economic censuses are conducted by the U.S. Census Bureau every five years—for years ending in two and seven. The Bureau of Economic Analysis (BEA) uses the results of these economic censuses to generate very detailed benchmark supply-use tables

(SUTs). Using both extrapolation and interpolation techniques, BEA leverages these detailed tables in combination with a variety of data sources to develop annual SUTs that are published for intercensal years. In addition, similar data sources and techniques are used to develop the quarterly SUTs which underpin BEA's quarterly GDP-by-industry statistics. In this paper, we present and discuss the methodologies used to develop these non-benchmark SUTs.

North American Sub-National Model of Import Competition and Jobs

Topic: (7.7) Region/country-specific analysis (3)

Author: Ross James Hallren

Utilizing OECD ICIO data, U.S. BEA survey data, and Canadian inter-provincial SUT data we construct an Inter-North American, sub-national Armington CES type industry-specific model that quantifies the impact of trade policy on workers in the NAFTA region, while allowing transportation costs separate product and labor markets into sub-national regions. We contribute to the literature by introducing a parsimonious model that allows for heterogeneity in the policy impact across sub-national regions, which is typically lost because most data are collected at the national level. We use the model to simulate the impact of a hypothetical ten percent reduction in the cost of importing household appliances from China on employment in the competing North American industry. The model illustrates, in a simple way, how nationally uniform changes in trade policy or in other costs of importing can have significantly different effects on employment in different parts of a country, depending on differences in import penetration into the regions. We present two cases. In the first case, the national product market is fully integrated nationwide and in the second case the product market is separated into regions and there are no inter-regional shipments. In the second case, the employment effects vary across the regions. These extreme market integration scenarios define lower and upper bounds on the differences in employment effects across the regions. An extension of the model that includes inter-regional shipments provides intermediate estimates of employment effects that again vary by region.

Effects of Sector Aggregation on Production Functions: A Study on Substitutions between Production Factors

Topic: (8.2) Methodological Aspects of Input-Output Analysis (3)

Author: Gilang Hardadi

Co-Authors: Stefan Pauliuk, Yasushi KONDO, Richard WOOD

Rapid transformations in industrial activities are urgently required due to the need to reduce environmental pressure as populations and economies grow. Researchers have constructed models of industrial processes to simulate the transformations, in which production functions are often used to examine substitutional relationships between production factors in aggregated sectors. Input-Output (IO-) time series are suitable to initially examine changes in the capital and labor involved and energy and material consumed in the industrial processes of specific sectors. This procedure serves as a foundation to further investigate the fit of those changes in production functions.

This study aims to investigate the adeptness of different production functions comprising capital, labor, energy, and material to describe changes in economic activities over time, across regions, and with sectoral aggregation. EXIOBASE 3.0 serves as reference IO-database due to its detailed

sectoral resolution to facilitate aggregation and its rich historical time series from 1995 to 2011. Capital-intensive, labor-intensive, energy-intensive, and material-intensive sectors will be selected cases for further analysis. Production functions of those sectors are modelled on different levels of sectoral aggregation in a bottom-up manner. Selection of aggregation level is critical since substitutability assumption might be expedient in aggregated level, but its practicability is limited in individual production plants.

Production functions generated from this study provides statistical evidence in selecting appropriate levels of aggregation and functional forms and characterizing technological structure in selected sectors and countries. This study provides understanding of substitutions between production factors in an aggregated sector, which can assist policy makers in developing appropriate economic strategies based on national characteristics of each countries. The result exhibits at which aggregation levels significant degrees of substitution between production factors exist. It also indicates the possibilities for substitution between capital stock and material input as well as energy and labor required, depending on aggregation level.

Evaluating the Impact of Tourism in Salta, Argentina: a Regional Input output and CGE analysis

Topic: (10.7) Regional input-output modeling (2)

Author: Federico Haslop

Co-Authors: Leonardo Javier MASTRONARDI, Carlos Adrian Romero, JUAN PABLO TARELLI

Tourism is an important source of income for the Argentinian economy, representing more than 5% of its GDP. In the province of Salta, a recipient of not only national but also international tourists, this industry gains special relevance, standing for 30 % of its regional GDP. The aim of this paper is to quantify the impact of an increase in Salta's tourism while capturing both direct and indirect effects on the regional as well as the national economy.

We consider that a hybrid regional SAM (RSAM) is the appropriate tool for accomplishing analysis of this kind. For the construction of the RSAM different sources of information were used: i) Survey data from households, ii) Production surveys of tourism industry firms (such as hotels and restaurants), iii) non-survey estimations of an IRIO including additional data in order to improve its results.

The regional SAM includes 16 sectors of which 6 are related to tourism (this are: commerce, hotels, restaurants, tourism related transport and tourism related services).

The RSAM allows us to simulate the impact of an increase in regional tourism with different models: On one hand a set of input output models and on the other hand a multiregional CGE model.

The results show that: a) Under an extended IRIO the "tourism multiplier" lays between 0.89 and 0.95 for each additional dollar spent in tourism, b) When considering the CGE model, an increase of 2% in total demand causes a 0.25 % growth of the regional GDP while improving fiscal results of the local government, c) Effects to the Argentinian economy as a whole are positive but of an irrelevant magnitude, d) The results are sensitive to capital property and mobility (in regional terms).

Indirect emissions and carbon mitigation: Structural analysis of IPCC sectors

Topic: (3.5) Designing of Energy Policies with I-O

Author: Edgar Hertwich

Co-Authors: Richard WOOD

Only 6% of global greenhouse gas emissions occur in buildings, yet buildings are designated as a sector worthy of its own chapter in the IPCC WGIII report series, based on indirect emissions caused during production of electricity consumed in buildings. However, the account of indirect emissions in the IPCC report is incomplete, restricted to electricity and systematically ignoring the construction of the buildings and the inputs of products, services, heat, and fuels. A more complete, life-cycle based assessment of emissions would provide a clearer view of the scope and consequences of mitigation actions within each sector. We conduct an input-output investigation of direct and indirect greenhouse gas emissions for each of the five IPCC sectors, energy supply, transport, industry, buildings, and agriculture & forestry, applying consumption based accounting and Hypothetical Extractions method to the EXIOBASE multiregional input-output model. Relating emissions to services provided to final consumers, we find that industry is by far the most important sector with 22 GtCO₂e in 2007, followed by buildings with 13Gt and transport with 5 Gt. The construction and operation of buildings causes indirect emissions in the industry sector that are larger than the direct emissions of the buildings sector, but today outside the scope of analysis of the buildings chapter of the IPCC. The largest flows of indirect emissions are from the energy to the industry sector and from the industry to the building sector. Accounting for both direct and indirect emissions of each sector using the hypothetical extraction method, we show that industry affects two thirds of all emissions, buildings 22%, while transport and agriculture are about equally important with 16% each. Our work suggests that given its narrow system boundaries, the IPCC seriously risks underestimating the influence of sectors over emissions and thus not recognizing emission reduction opportunities. In particular, the role of industry is grossly underestimated, with most attention given to energy supply.

Estimating Input-Output Tables from Supply-Use Tables: An Evaluation of the Impacts of Alternative Methods

Topic: (5.5) Input-Output Accounts and statistics (2)

Author: Geoffrey J.D. HEWINGS

Co-Authors: Joerg Beutel, Ayele Ulfata Gelan

Abstract: There are four basic transformation methods available for converting supply-use tables into symmetric input-output tables: (1) Product technology assumption (Each product is produced in its own specific way, irrespective of the industry where it is produced); (2) Industry technology assumption (Each industry has its own specific way of production, irrespective of its product mix); (3) Fixed industry sales structure assumption (Each industry has its own specific sales structure, irrespective of its product mix) and (4) Fixed product sales structure assumption (Each product has its own specific sales structure, irrespective of the industry where it is produced). Two other transformation models are used in practice: the model based on hybrid technology assumption and the Almon procedure. The hybrid technology assumption combines the product technology assumption and the industry technology assumption to avoid negatives in product by product input-output tables. The Almon procedure is an alternative to compile product by product input-output tables which are based in essence on the product technology assumption but avoid negatives in the derived input-output tables. Drawing on a recently compiled set of tables for

Kuwait based on 2010 data, this paper explores the results of using input-output models derived under these different assumptions for impact analyses using a series of randomly generated final demand vectors. Are the differences in outcomes analytically significant and can these differences be traced to changes in the location of analytically important coefficients?

Economy-wide Impacts of Income Inequality: Some Initial Explorations

Topic: (9.1) Special Session: Income Distribution in IO Models: Miyazawa Revisited (2)

Author: Geoffrey J.D. HEWINGS

Co-Authors: Kijin KIM

The renewed interest in the measurement and trajectory of income inequality within and between countries has revealed complex patterns whose interpretations are very sensitive to the time periods chosen, the spatial frame employed, the composition of income (especially the inclusion of non wage and salary income) and the methodology that is used. However, relatively few attempts have been made to exploit the opportunities to consider the economy-wide implications of income inequality or to explore the ways in which the circular flow of income might contribute to sustaining inequality. In this paper, some initial explorations are provided that position income receipts and expenditures in an analytical framework that captures the interdependence between income groups rather than focusing on income inequality per se. The framework exploits the work of Miyazawa (1976) whose estimation of an interrelational income multiplier matrix made possible an enhanced understanding of income dynamics within an economy. The system is estimated for the Chicago metropolitan region and a comparison of findings for 2009 (base year) and 2020 (forecasts) reveal some unexpected changes in the structure of the interrelational income matrix.

Harmonisation of the Australian Energy Hybrid Accounts with the Input-Output Tables

Topic: (5.5) Input-Output Accounts and statistics (2)

Author: Khanh Vy Hoang

Environmental-economic accounts record the transactions in monetary terms between economic units that may be considered environmental and deliver necessary extensions to System of National Accounts (SNA). The environment-economic accounts produced, to the extent that it is conceptually possible, should align with the SNA accounts to allow for consistent analysis of the contribution of energy to the economy, the impact of the economy on the energy resources, and the efficiency of the use of energy resources within the economy.

One of the sets of environmental-economic accounts produced by the Australian Bureau of Statistics (ABS) is the satellite energy account comprising physical and monetary supply and use tables, energy asset tables and a hybrid energy use table. This paper outlines the recent work by the ABS towards the integration of the energy account with the existing SNA accounts - the Input-Output tables. The satellite energy account is compiled based on the System of Environmental-Economic Accounting (SEEA). Thus, in theory, the harmonisation of these accounts should be relatively straightforward. However, in practice, some challenges exist. The paper will examine the conceptual and methodological issues in energy resources accounting and describe in detail the source data and the valuation methods used by the ABS. The practical challenges of

the harmonisation process and the long-term plan to align other sets of environmental-economic accounts with the core SNA accounts are also discussed.

Examining the cost-effective investment for the 6th industrialization for Taiwan - An approach of dynamic CGE model

Topic: (1.4) CGE Modelling (1)
Author: Michael C. HUANG

For advanced economies highly involved with global economy system, increasing the value-added agriculture has become a vital issue. Improving the competitiveness of agricultural products and the wage level of farming-related labor is regarded the top priority. Japan has been advocated the The 6th industrialization include the procession of the farming (first industry), food manufacturing (second industry) and marketing (third industry). The rapid development of information and communication technology (ICT) has further facilitated the 6th industrialization in the countries such as Taiwan and South Korea.

The study aims to analyze Taiwan's 6th industrialization by examining the cost-effectiveness of government's capital investment on the agriculture service, food and ICT manufacturing to review their spill-over impact and welfare change on household. By using the Taiwan's input-output table of year 2011, we aggregate 5 sectors from agriculture: (1) crops, (2) fruit & vegetable, (3) fishery, (4) livestock and (5) other agriculture. We apply a recursive dynamic CGE model to simulate the capital-investment on (a) agriculture service, (b) food production and (c) information service and examine the cost-effectiveness by comparing the the output change, rise of labor price on the 5 agricultural sectors mentioned above, as well as the household welfare.

The study expects to provide a visualized impact of capital-investment on agricultural sectors and investigate the spill-over impact on technology. By viewing the simulation results, the policy makers may better understand the flow of capital service to reinforce the weakness in order to make more cost-effective decision for the 6th industrialization in Taiwan.

An Input-Output Study of the China Information Sector

Topic:
Author: Yongming HUANG
Co-Authors: Xiaofei Chen, Xiaoli nan

In this paper, data for Chinese 2002, 2007 and 2012 input-output tables are used to investigate the impact of information technology on the output growth of Chinese economy. We adopt the input-output approach to shed light on both production and diffusion activities of the information sector on the Chinese economy. Based on dynamic structural decomposition analysis(SDA), we also identify the sources of growth in the information sector. The results indicate that the ICT sector provided the key linkages for the expansion of service sector and technological intensive manufacturing sector for the Chinese economy and the demand for information technologies from manufacturing sector is growing faster than that from service sector. In particularly, there is the tendency in IT industry of which the driver of growth is changing from export to domestic demand.

How Structural Change in CEE Countries Influenced Demand for Labor

Topic: (6.7) Region/country-specific analysis (2)

Author: Martin HUDCOVSKY

Co-Authors: Eduard Nezinsky

The importance of structural change was proved (among others) to be a significant driver of employment development in the region of Central and Eastern Europe. However, this overall effect does not provide the desired insights to the quality of such employment growth. Therefore, the qualitative aspect of the employment change needs to be addressed for the proper evaluation. To do so, the paper utilizes the structural decomposition analysis for qualification breakdown of the labor force.

Moreover, also the quality of economic growth has altered over time in analyzed countries. The growing importance of external demand seems to generate qualitatively different outcomes in labor market than traditional domestic demand used to in the past. The influence of this driver is also elaborated in the paper. Data necessary for analysis are sourced from WIOD database covering the period 1995 – 2009 (due to the availability of data with the volumes in prices of previous year mitigating the bias of results with inflation).

The achieved results provide a better understanding of labor market development in CEE countries with the identification of significant effects of structural change on labor demand in qualification aspect.

Chinese Oil Import under China Pakistan Economic Corridor (CPEC) - A Global Commutable General Equilibrium approach

Topic: (4.7) Region/country-specific analysis (1)

Author: Muhammad Iftikhar ul Hasnain

Co-Authors: Muhammad Aamir KHAN

Ever since the establishment of diplomatic ties, China sees Pakistan as a committed ally. Both countries have maintained cordial ties successfully through thick and thin and both have been serving each other's interests. China-Pakistan Economic corridor (CPEC) is one such example. It is a policy initiative taken by the governments of Pakistan and China in 2013. This corridor is an excellent opportunity to improve the economic and regional connectivity. It is a \$46 billion Chinese investment, covering a wide range of different energy, infrastructure and industrial projects in Pakistan. Pakistan, in turn, provides a cheap and short route to transport Chinese imports. China's huge energy demand made it the world's second largest importer of oil. China largely depends on Middle Eastern countries to satisfy its trade and energy needs. It previously used the South China Sea to ship oil through the Strait of Malacca, which cost them more than 70% of the cost of actual imported oil. CPEC, on the other hand, provides the shortest route that could reduce the transportation cost by 50%.

With this backdrop, this study adapted a new global commutable general equilibrium (CGE) model using latest GTAP Power data set and latest Social Accounting Matrix (SAM) of Pakistan. The economy wide results show that China would earn huge return on its investment under CPEC in the form of positive impact on real GDP and trade. Pakistan could earn toll tax on every consignment transported from Gwadar in Pakistan to Kashgar in China. This tax would increase

Pakistani government revenue by 1% and real GDP by almost \$100 million.

An Input-Output Analysis on the Demand-Supply Structure of Textile-Clothing Industry of Bangladesh & Asian Competitors

Topic: (9.5) Input-output Analysis for Policy Making (4)

Author: Kazuo Inaba

Co-Authors: Md Masum

The objective of the paper is to know the demand-supply structure of the textile and clothing industry (TCI) of China, Bangladesh, India, Viet Nam and Indonesia which are the top five clothing exporting nations in the world and control 90% clothing exports of the region.

The methodology of the paper is input-output analysis including multiplier analysis, structural decomposition analysis, linkage analysis with detailed backward linkages to clothing industry and analysis of vertical specialisation using National Input-Output Tables and Interregional Input-Output Tables of the economies.

The results show that among the economies, the domestic multiplier effect of China is the highest. The domestic multiplier effects are 3.09, 2.35, 2.17, 2.14 and 1.60 times for China, Viet Nam, India, Bangladesh and Indonesia respectively in 2011. In the growth path, the contribution of final demand effect outplayed technical change effect, whereas export contribution is much higher than domestic demand expansion.

Technical effect during 2000 to 2011 period in TCI is highest in Viet Nam (18%) followed by China, India, Bangladesh, and Indonesia. Value added export (VAX) has changed positively by 14% in China, 8% in Bangladesh from 2000 to 2011 period. On the other hand, VAX has changed negatively in Indonesia, India and Viet Nam. So, the demand side and the supply side structure of China is very good in the region followed by Viet Nam, India, Bangladesh and Indonesia.

Development of analytical frameworks for global value chains: the role of input-output analyses

Topic: (3.4) Special Session: Understanding the Most Recent Evolution of Global Value Chains: New Approaches Based on New Databases

Author: Satoshi INOMATA

The development of multi-country input-output tables (IOTs) in recent years has been primarily driven by the academic and policy decision-making interests in two key areas of global value chains (GVC) governance.

The first area is the link between the environment and the economy. There is a growing need to respond to the range of data demands for environmental analyses that cover policy, regulation, taxation, and, more generally, better understanding of the cross-border impacts of economic activity on the environment. The study of "carbon footprint" addresses questions such as whether to attribute the global warming to producers' responsibility or to consumers' responsibility. The multi-country IOTs with environmental extensions (for example, carbon intensities, etc.) provide a powerful analytical tool for tracking the footprint of production activities all over the world.

The second area of interest relates to the rapidly changing features of international trade and governance. The "trade in value-added" analysis attempts to trace international flows of value-added embodied in traded products across economic activities and countries. The traditional approaches in the study rely heavily on the information sourced from individual firms. The multi-country IOTs based analysis complements these traditional approaches, yet provides a

wider perspective for analyzing the nexus of inter-industrial linkages at the global scale. The purpose of the current paper is to trace the development of analytical frameworks for GVC studies, with a particular focus on the contribution of input-output analyses to the field. The paper summarizes the various preceding challenges for a quantitative description of GVCs. It also addresses some pressing issues to be considered for the future advancement of the empirical studies on GVCs.

Who Works for Whom in South Korea: An MRIO Structural Shift-Share Decomposition Analysis, 2003-2013

Topic: (10.6) Structural Decomposition Analysis

Author: Hyunjoo Jang

Co-Authors: Erik DIETZENBACHER, Michael L LAHR

Compared to most other OECD nations, employment growth in South Korea has been fairly slow. Some researchers have suggested this is due to the slow pace of regulatory reform there compared to that going on in other nations. But it could also be due to lifestyle changes of Korean households, international competitive pressures (e.g., the rise of China's economy), shifts in the nature of the nation's capital investments, and changes in the composition of the nation's exports, among other possibilities. We examine such potential proximate causes across regions of South Korea using a structural decomposition approach. In this paper we apply, for the first time, a shift-share version of structural decomposition analysis developed elsewhere by Dietzenbacher and Lahr (2017). We use data from for regions of South Korea for 2003, 2005, 2010, and 2013 as published by the Bank of Korea. These data are quite detailed, containing 16 regions with 82 industries per region. We interpret the findings on the proximate causes of employment change using seven (7) components by broad sector by region in light of known interregional relocations, international trade agreements, regulatory and other differences across the regions of South Korea.

The Impact of Geographic Shifts in International Sourcing on Global CO2 emissions

Topic: (5.3) International Trade (2)

Author: Xuemei Jiang

In this paper we simulated the emission cost of geographic shift of international sourcing on global CO2 emissions for the period 1995-2011 by comparing the scenarios with and without geographic shift. Our simulations indicate that in 2011, had the share of trade by sourcing economy remained in the level of 1995, 2000, 2005 and 2008, global CO2 emissions in production processes would have been 2.8 Gt, 2.0 Gt, 1.3 Gt and 540 Mt lower than the actual emissions. Although the outsourcing trend shifted from developed economies to developing economies has been slow down after the international crisis in 2008, the overall emission costs have always been significantly positive. The further investigations by economy and industry show that such geographic shift mainly dominated by developed economies themselves, and occurred in high-tech industries such as productions of ICT goods and machinery, leading to positive emission cost in developing economies especially China. Our results addressed the urgency of eliminating in carbon emission intensity between developing and developed economies.

R&D expenditure and economic growth: how has changed globalization the current outlook?

Topic: (2.3) Structural Change and Dynamics (1)

Author: Sofía JIMÉNEZ

Co-Authors: Rosa DUARTE, Julio Sánchez Chóliz

There is certain consensus in economic literature on the factors that have influenced historical differences in growth patterns observed between developed and developing countries. However, it is less clear how structural elements have marked growth differences in developed economies in recent decades and how these different patterns have conditioned their economic outcomes in the context of the global economic crisis.

R&D has been traditionally studied as a key factor explaining economic growth in developed economies. In fact, significant bulk of literature has provided evidence on this relationship (Griffith (2004) among others). Despite that, recent economic literature has also focused on the role that indirect and imported R&D expenditure (imported R&D) and R&D spillover effects (Vitucci et al (2011) or Seck (2011)) have played boosting economic growth. This indirect influence becomes more evident in a context of increasing globalization and production fragmentation scheme.

In this context, our paper has two main objectives; to study how globalization has changed the world map of R&D flows and their role in economic growth, and to approximate to the temporal gap existing from the R&D investment to the effects on economic growth. Regarding the first objective, we propose a methodology to modify the traditional R&D embodied in demand. The change is mainly based on the concept of country-specific absorptive capabilities (Verspagen, 2016). In order to capture these differences we propose to use a weighted based index depending on the specialization structure.

On the basis of this measure, we formulate an econometric two -equations model to address two important issues: First, how globalization has changed R&D role on economic growth, with an increasing importance of external flows over direct R&D investment itself. Second, our results suggest that immediate R&D investment barely affects labour productivity as most literature tends to assume. In fact we find that there is at least a three years gap depending on the period considered.

Double dividend strategy for clean development: Allocating consumption based environmental responsibility of coal production amongst Indian states

Topic: (5.6) Special Session: Shifting Scales of Macro-econometric Modelling to State-Level Economic, Energy and Environmental Policy Analysis for India(E3-India)

Author: Surabhi R. JOSHI

Organized Sessions

Session Organiser: Kakali Mukhopadhyay, Department of Agricultural Economics McGill University, and Gokhale Institute of Politics and Economics, Pune, India

Session Chair: Kakali Mukhopadhyay, Department of Agricultural Economics McGill University, and Gokhale Institute of Politics and Economics, Pune, India

Title: Double dividend strategy for clean development: Allocating consumption based environmental responsibility of coal production amongst Indian states

Presenter: Surabhi Joshi, Coordinator (India), Regulatory Assistance Project's E3-India Project
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Abstract

The study explores impacts of developing effective interstate compensation mechanism for allocating consumption based environmental responsibility of coal production amongst Indian states. Major coal bearing states of India (Jharkhand, Chhattisgarh, Odisha, Madhya Pradesh and West Bengal) are characterized by low economic growth and poor development trajectory. Further the quality of life of the population in the states is compromised due to huge environmental burden of coal mining process.

The paper simulates impacts of policy intervention where consumption based carbon tax is imposed over high GDP, high energy consuming states of India and tax revenue is used in coal bearing states for a) Increasing Process efficiency & b) Enhancing House hold social security using E3 India modelling tool.

E3 India is a dynamic macro-econometric simulation model which provides an integrated treatment of the India's state economies, energy systems and emissions along with capturing two way linkages and feedback (E3). The baseline simulation available till 2035 was modified to include following state specific policy interventions

1. A Rs 400/ Ton of carbon consumption tax on high GDP & High energy consuming states
2. The revenue tax is used towards
 - i) Investments in Process efficiency in coal bearing states
 - ii) Investments in Social transfers in coal bearing states

Initial trend run indicate that a carbon tax enhances energy efficiency in high energy consuming states while energy efficiency incentives improve environmental performance of coal bearing states. Further increased social security leads to poverty reduction indicated by improved disposable income or consumer spending in the states.

The study thus provides an evidence towards scope, effectiveness and synergies of consumption based taxation as a strategy towards cleaner development for an emerging economy like India.

Employment and GHG Emission Effects of Grid Connected Solar PV Deployment in India: A Multiregional Input Output (MRIO) based Analysis

Topic: (10.1) Emerging developing countries

Author: Surabhi R. JOSHI

Co-Authors: Pritee Sharma

There has been prevalence of differentiated incentives for solar power projects utilizing domestically produced solar panels (DCR) from those using imported solar panels in India. The recent WTO ruling against Indian solar DCR content urges a need for comprehensive assessment of economic, environmental and social impacts of the two modes of solar deployment categories thus better understanding effectiveness of DCR as policy instrument for leveraging the green growth opportunities implicit in the existing ambitious solar scale up target for India.

This paper constructs a multiregional input output model for two categories (DCR & Open to import) of solar deployment in India and studies economy wide employment and emission impacts transacting across economies. The analysis involves estimation of GDP, employment generation, distributive efficiencies of wage generated and embodied GHG emissions of the solar

deployment process in India and economies of China and Germany, that substantially contribute to imports associated with solar deployment in India.

The results show that gross GHG emissions associated with DCR based solar deployments is 58.2 % higher to the open category deployment however emission coefficient of associated GDP generation (KT of CO₂/ unit of GDP) is only marginally high for DCR deployments (2.04%) . The results also show that domestic manufacturing leads to greater high skill wage generation in high tech industries for India when compared to imported panel deployment. The wage generation for Germany lies predominantly in medium and high skill sector while China generates predominantly medium and low skill labour in the deployment process.

The positive trend of moving towards greater high quality jobs in India as demonstrated by the domestic manufacturing option indicates a possibility to move up the value chain but the condition of greater GHG emissions accentuates the Development-Environment paradox for India as an emerging economy.

The paper thus highlights a strong case for interventions towards facilitating appropriate and affordable technology transfer for enhancing process efficiency so as to not only avoid suboptimal lock-ins of global resources but also establish socially optimal solutions for energy transitions in developing economies.

Effects of the CAFE standards on CO₂ emissions in Japan

Topic: (1.7) Sustainable production and consumption

Author: Mitsuki KANEKO

Co-Authors: Shigemi KAGAWA

Since the Paris agreement was adopted on 12 December 2015, the global warming issue has become important increasingly. According to the report of the Ministry of the Environment of Japan (Ministry of the Environment of Japan, 2016), transportation sector occupied a large portion of 18% in the total amount of CO₂ emissions of Japan in 2015 and especially 86% of the emissions from transportation was caused by the automobile sector (Ministry of Land, Infrastructure, Transport and Tourism, 2016). The Japanese government will introduce the Corporate Average Fuel Economy (CAFE) Standard that has been already introduced in the U.S., aiming that CO₂ emissions from the transportation sector will be reduced more aggressively and the automobile market will be expanded through shifting toward a more flexible fuel regulation (Ministry of Land, Infrastructure, Transport and Tourism, 2011). This study estimated the corporate average fuel economy of the three car manufactures (Toyota, Nissan, and Honda) by using the detailed new car sales data by car models and companies in 2015 (Japan Automobile Dealers Association, 2016) and the fuel economies data by car models and companies (Ministry of Land, Infrastructure, Transport and Tourism, 2016). Using CO₂ emission inventories such as environmental input-output database, we further estimated the life-cycle vehicle emissions by 15 vehicle weight classes of a company under the corporate average fuel economy case. The results show that Toyota attains the CAFE standard in 2015, whereas Nissan does not attain it. However, an important finding is that even if Toyota attains the CAFE standard, the life-cycle vehicle emission of Toyota is much higher than that of Nissan. We finally conclude that the government should introduce the CAFE standard considering the life-cycle vehicle emissions.

Modeling changes in technology-mixes due to climate policy

Topic: (6.5) Methodological aspects of IO analysis (2)

Author: Arne KÄTELHÖN

Co-Authors: André BARDOW, Sangwon SUH

Climate policies are commonly assessed based on aggregated economic models such as computational general equilibrium models. These models capture the effect of climate policies on the whole economy or individual sectors, but cannot determine changes in technology mixes used to produce individual products. Determining such changes, however, is crucial to understand the impact of climate policies on the potential introduction of novel environmentally friendly technologies.

Building on the Rectangular Choice-of-Technology (RCOT) model by Duchin and Levine (2011), Kätelhön et al (2016) developed a stochastic model that helps understand changes in technology mixes at an engineering-level detail: the Technology Choice Model (TCM). In TCM, technology mixes are determined by a cost minimization objective, considering constraints in factor availability and uncertainties in process parameters, factor requirements, and factor prices.

In this work, we adapt TCM for climate policy assessment, and demonstrate its application in a hypothetical case study on the production of biofuels and corn. We show the model's ability to determine changes in technology mixes in response to the introduction of an emissions trading scheme. We further illustrate the interdependence between technology mixes and production volumes of fuel and corn within the model, and discuss their impact on land use and climate. The case study results in a non-linear relationship between potential climate impact reductions and the price of emissions certificates within the emissions trading scheme.

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Measuring the Impact And Recovery Pattern of Flood Using Dynamic Input Output Inoperability Model (DIIM): Pakistan a Case in Point

Topic: (9.2) Dynamic IO Modeling and Analyses of Capital Formation

Author: Muhammad Abdullah Khalid

Co-Authors: Yousaf ALI

MEASURING THE IMPACT AND RECOVERY PATTERN OF FLOOD USING DYNAMIC INPUT OUTPUT INOPERABILITY MODEL (DIIM): PAKISTAN A CASE IN POINT

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Abstract

A disaster such as a flood can produce a sudden effect on interdependent infrastructure and economic sectors. Subsequently, it can reduce production-as-usual and cause significant economic losses. Therefore, forecasting the degradation of disrupted sectors and interval to recover from the dysfunctional state is essential to lessen the aftermath of the disaster. The resilience put forward by the critical sector or their ability to recover from the disruption can also reduce the consequence of the disaster. In this paper, resilience and recovery time are quantified through the application of Dynamic Inoperability Input-Output model (DIIM). DIIM is an application in I-O analysis which allows evaluating the resilience parameter and pattern of the inoperability level of interdependent sectors which propagates with respect to the time. In this paper, a case study is performed on the flood that hit Pakistan in 2011-12. The purpose of this study is to perform a case study in a developing country scenario to estimate the inoperability and economic loss caused by the particular disaster. Furthermore, to analyze the recovery pattern of affected sectors. To perform the analysis, Input-Output (I-O) table is constructed for Pakistan's economic system. The I-O table is constructed by utilizing different governmental and private resources. Findings of the research show that most of the critical sectors in terms of inoperability and economic loss are associated with agricultural and service sectors respectively. Furthermore, the article also develops a time varying output recovery to account sector recovery pattern after the disaster. The outcome will be essential for the policy makers and disaster management authorities to assess the resilience of each economic sector and plan accordingly in future to mitigate the consequence.

Assessment of Oil price shock on Chinese Economy: Macro Multiplier Approach

Topic: (9.3) Energy Input-Output Modeling (3)

Author: Atif Maqbool Khan

Co-Authors: Maurizio CIASCHINI, Rosita PRETAROLI, Francesca SEVERINI, Claudio SOCCI

According to IMF, Chinese economy is second biggest economy by GDP measured in nominal units and world largest economy when GDP is measured in PPP terms. The Chinese economy is world fastest growing economy of the world by average growth rate is approximately 10% annually until the year 2015. Due to excellent economic growth rate, China firstly started the import of crude oil in 1993 for fulfilling the production requirement of the economy. In the mid-2013, domestic oil fields of China adversely damaged due to flood, the oil imports of China drastically increase and China becomes first in oil imports by surpassing USA. At present, 6% Chinese imports consist of crude oil. In the period between June and December, 2014 due to restoration of oil production in Iraq and Libya; increase in the production of unconventional oil (Shale oil consisting of 5% global oil production); weakening global demand, the prices suddenly fell around 44% or \$49 per barrel. Per mainstream macroeconomic studies, it is forecasted that due low oil prices, the global GDP increased by 0.5% in mid of 2014. The present study contributes to the literature in achieving the objective by analyzing the impact of current oil price shock on the different industrial sectors of China. The empirical analysis will be carried out by making use the Macro Multiplier (Chiaschini and Socci, 2007) Multisectoral approach on the latest available input-output tables constructed for the year 2014—later released in 2016 by WIOD. The findings will reveal the updated picture of Chinese economy—growing at approximately 6% annually.

Analyzing Effects of Mega Transportation Projects on Regional Economies of Northeast Asian Countries

Topic: (4.5) CGE Modelling (2)

Author: Euijune KIM

Co-Authors: Seung-Woon Moon

We develop a Multinational Multiregional Computable General Equilibrium (MMCGE) Model to analyze economic impacts of the Asian Highway 1 and Korea-Japan Tunnel on regional economic growth of Northeast Asian countries. The growth sources from the construction of the highway originating from Japan to China via Korean peninsula are classified into two components; (1) reduction in the travel time (cost), and (2) a decrease in transportation cost per time (distance). The direct and indirect effects on economic benefits are generated through the supply and demand linkages among economic agents. Overall, the construction of missing link of Asian Highway #1 in North Korea's section and Korea-Japan Tunnel has the large effects on the GRP of Dongbei in China, Seoul Area in Korea, and Kyushu in Japan. The simulation of the MMCGE model can provide public agents and stockholders with analytical and strategic insights into the investment efficiency, effectiveness and priority of the highway project in terms of income growth. This numerical model is expected to practically assess transportation investment programs and development strategies with the national and regional economic goals

Input-Output approach as an instrument for estimation of potential national ecological targets

Topic: (4.6) Special Session: Input-output Approach and Impacts of Economic Policy in the Emerging Markets (2)

Author: Andrey Kolpakov

Co-Authors: Alexander Shirov

Attention to reducing the negative anthropogenic impact, especially carbon dioxide (CO₂) emissions, is an important part of current vision of sustainable global economic development. International collaboration in these areas has led to the adoption of the United Nations Framework Convention on Climate Change (1992) and the Kyoto Protocol (1997), which specify the obligations of a number of countries to limit their CO₂ emissions. In December 2015 the Paris Agreement was adopted. According to this agreement, each party shall set and achieve nationally determined contributions to the global response to climate change.

However, many developing countries are considering the subject of CO₂ emissions limitations as a way to restrict their economic and technological development, as well as to maintain the leadership of developed countries in the world trade.

Currently aggregate CO₂ emissions generated by national production sectors (production-based CO₂ emissions) serve as a criterion for determining countries emissions. This methodology does not take into account the international carbon flows in the form of commodities produced in one country and consumed in another one, although up to 25-30% of worldwide CO₂ emissions are concentrated in such operations. And the serious question is Who shall be responsible for CO₂ emissions generated during the production of commodities in developing countries, which are subsequently sold to and consumed by other countries? A possible answer is the applying of consumption-based CO₂ emissions approach.

Consumption-based (Econs) and production-based (Eprod) CO₂ emissions are related through the following ratio: $E_{cons} = E_{prod} - E_{exp} + E_{imp}$, where E_{exp} - export-associated CO₂ emissions and E_{imp} - import-associated CO₂ emissions.

The suitability of this methodology for forming a position in negotiations of future CO₂ emissions limitations is obvious, as it allows to share the countries responsibility more elaborately. With this approach there are additional incentives for greater investment by developed countries in manufacturing sectors of developing ones for reducing the carbon intensity of imported goods. However, it requires more complicated calculations.

The subject of CO₂ emissions limitations is very important for the Russian economy in view of significant role of energy-intensive exports.

Research is devoted to estimation of Russian CO₂ emissions under different methods. A key objective is to analyze the possible levels of CO₂ emissions limits for Russia, which would not restrict its economic development in the long term.

We use Multi-regional input-output (MRIO) approach based on WIOD Database - World Input-Output Tables and Environmental Accounts. Institute of Economic Forecasting of Russian Academy of Sciences (RAS IEF) releases up-to-date input-output tables for the national economy and uses them for forming macrostructural models for forecasting the dynamics and structural characteristic of the economy in the long term. That is why WIOD data for Russia is replaced by own information in the calculations.

According to our estimates in 2013 Russian export-associated CO₂ emissions were 580 MtCO₂, imports-associated emissions - 120 MtCO₂, production-based emissions - 1740 MtCO₂ and consumption-based emissions - 1280 MtCO₂. The largest industries exporting CO₂ were electric power sector (34%), metallurgy (22%), mining and quarrying (16%), transport (9%), production of coke and refined petroleum (9%) and chemical production (5%). The largest import CO₂ flows were associated with electric power sector (20%), agriculture (12%), metallurgy (11%), chemical production (10%), textile manufacturing (9%), transport (9%), production of coke and refined petroleum (6%), production of transport equipment (3%) and machinery (2%).

Analyzing possible long-term emissions limitations, we use two conditional levels: "Kyoto" (100% of Russian CO₂ emissions in 1990) and "Paris" (75% of Russian CO₂ emissions in 1990) ones. We consider two scenarios of the Russian economy development: Reference ("inertial") and Accelerated Modernization (annual GDP growth rate is comparable to the world average).

We conclude that the consumption-based approach is more beneficial for Russia in terms of emissions limitations. We show that up to 2030 Russia will not reach the 1990 level of CO₂ emissions in any scenario. However, in Accelerated Modernization scenario Russian CO₂ emissions in 2030 will be very close to 1990 level. Moreover, in this scenario "Paris" level will be exceeded after the 2025. There is considerable risk that only inertial scenario will be possible for Russia if 75% limit level is used as nationally determined contributions.

This means that the condition about taking into account the absorption capacity of forests, which Russia insists on, is important for Russia to ensure sustainable long-term economic growth.

Detecting what drives a social issue: Forward structural path analysis with an integrated multiregional input-output framework

Topic: (1.6) Environmental IO Modelling (1)

Author: Yasushi KONDO

Co-Authors: Norihiro Itsubo, Shigemi KAGAWA

Input-output analysis (IOA) has been widely used to footprint analysis, in which environmental burdens occurring at a number of sectors in various regions are added up to quantify the total burden (Hertwich and Peters 2009 Environ Sci Technol; Wiedmann et al. 2015 Proc Natl Acad Sci USA). The linearity and additivity assumptions on the environmental burdens and production structures are essential for application of this type. Given a growing interest in social issues in the literature of footprint and life-cycle assessment, in contrast, the inherent non-additivity of some

social impacts makes it difficult to naively apply IOA to social issues. It should be noted that there are at least two possible ways to tackle this difficulty due to non-additivity. One is to develop an appropriate method specific to a particular social indicator; for example, Alsamawi et al. (2014, PLOS ONE) proposed a method to quantify inequality footprints of nations. The other is to avoid addition and matrix multiplication, which we propose in this study.

We have developed a method of forward structural path analysis, to quantify which sectors are concerned in social problems. The method is applicable to a multiregional input-output (MRIO) table in an integrated input-output framework as well as a table in the conventional one. The method is particularly suitable for a social issue the place of which has already been identified, at least, at the sector level; for example, illegal logging in Indonesia and conflict minerals in Democratic Republic of Congo. We will introduce the developed method and present detailed results of its application based on the Eora MRIO table to a quantitative evaluation of social issues.

How does China's Labor Productivity Change as GVC Participation Deepening

Topic: (8.1) Productivity and efficiency analysis

Author: Yishu KONG

Abstract: China's foreign trade experienced rapid development since reform and open up, and its participation in Global value chains has been deepened as more and more industries and commodities involved. China's labor productivity, output per worker in broad sense, rose rapidly during the same period. To what extent can output per worker represent labor productivity, and what role does GVC participation play in the changing of China's labor productivity? Since total value added per worker, rather than output per worker can reflect the real productivity better, we calculated this index and compared the difference between three production modes: production for national use, processing trade, and normal trade, based on China's Non-competitive Input-Output Table capturing processing trade of 2002, 2007, and 2012. Then, using Structural Decomposition Analysis method, main influencing factors' contribution to the increase of labor productivity was analyzed. Finally, econometric model between labor productivity and GVC participation was established. The result shows that China's labor productivity fluctuated as GVC participation deepening, and production for normal trade was the most efficient, while processing trade was the least productive.

Keywords: China; Labor productivity; GVC participation; DPN table

Sustainable Development in North Rhine-Westphalia: a scenario analysis

Topic: (6.7) Region/country-specific analysis (2)

Author: Tobias Heinrich Kronenberg

Co-Authors: Antonia Kühn, Meike Schäfer, Johannes TÖBBEN

Sustainable Development is hard to measure, but most scholars agree that it entails the achievement of goals in three dimensions: environmental, economic, and social. In the past it was often believed that there are massive trade-offs between these dimensions, especially between the environmental and economic ones. However, intelligent strategies and new technology can make it possible to overcome some of these trade-offs. To shed some light on this, we present a

case study of a particularly interesting region: North-Rhine-Westphalia in Western Germany. North Rhine-Westphalia is a region characterized by massive economic and structural change. Historically it was the industrial core of the German economy, with important industries like hard coal mining and steel production. Hard coal mining has virtually disappeared, and so have many associated jobs. Unemployment is relatively high compared to the national average. Lignite mining, however, still plays an important role, and electricity production is heavily reliant on coal-fired power plants. As a result, greenhouse gas emissions per capita are significantly higher than the national average.

Under these circumstances, there is a lot of pressure on policymakers to stimulate job creation. The trade unions' association (DGB NRW) has called for the creation of 500,000 additional jobs (covered by social insurance) between 2014 and 2020. At the same time, however, greenhouse gas emissions must be reduced. The official goal of the government is to reduce greenhouse gas emissions by 25% in 2020 (compared to the base year 1990).

The goal of our study is to determine if and how both goals can be fulfilled. To this end, we develop a scenario analysis based on a multi-regional input-output (MRIO) model. First, we develop a business as usual (BAU) scenario, assuming that past trends will persist in the future. In this scenario, some additional jobs are created and emissions are reduced, but neither of the two goals is actually achieved. We then develop a "goal" scenario which describes a possible development in which both goals are achieved. Comparing the two scenarios shows how additional effort and measures can contribute to fulfilling employment and emission reduction goals.

The goal scenario draws on information which has been gathered in semi-structured interviews with decision makers in selected firms from several branches (mining, manufacturing, energy production and distribution, waste disposal and recycling, transport infrastructure, services). The interviews consisted of a quantitative part (energy consumption, total consumption of intermediate inputs etc.) and a qualitative part to identify challenges and potential strengths. The evaluation of the interviews allowed us to construct a plausible goal scenario.

At present, the project is not yet finished, it is currently "work in progress". Final results will be available at the end of February.

Harmonization of Regional and National Input-output models: the Case of Germany

Topic: (10.5) Methodological Aspects of IO Analysis (4)

Author: Tobias Heinrich Kronenberg

Co-Authors: Marc Ingo Wolter

Despite its federal structure Germany does not have official input-output tables at the subnational level. Although some regional statistical offices produced input-output tables in the past, these efforts have been discontinued in the 1990s. However, in the last few years there has been a resurgence of input-output modelling at the regional level, and input-output tables have been constructed, for instances, for the regions of Mecklenburg-Vorpommern (Kronenberg, 2010), Hamburg (Kronenberg & Engel, 2008), North Rhine-Westphalia (Kronenberg & Többen, 2011) and Thüringen (Sauer & Dettmer, 2014). Thanks to these efforts, there is now a much better foundation for regional economic studies than in the past.

At the same time, at the federal level there are input-output models which have been extended and thereby increased significantly in terms of complexity, for example INFORGE (Maier, Mönnig, & Zika, 2015). This is a macro-econometric input-output model fully consistent with the national economic accounts including the national input-output table, containing 63 branches, a detailed foreign trade module with 156 trading partners and 40 commodity groups, consumption

expenditure by private households based on the household consumption survey, consumption by the government divided into different purposes, investment by investing branch and divided into construction, equipment and other investment. The model also includes a disaggregated labour market with 63 branches, 50 occupation areas and 4 qualification levels. The regionalisation of the model results rely on a regional module which partly considers input-output relations.

Considering the availability of complex models at the national level and the increasing availability of regional input-output accounts raises the question how this wealth of data and model extensions can be usefully combined. In particular, we address two concrete questions:

1. For which regions do recent input-output tables exist?
2. How can these different tables (constructed by different authors using different methods and classifications) be made consistent with each other and with national models?

Concerning the first question we present a survey of the regional input-output tables that have been published since the turn of the millennium. The table includes information on the construction methods (survey, non-survey, LQ, CHARM...) and the format of the tables (number of branches/commodities, final demand, primary inputs).

To tackle the second question we sketch a possible modelling approach which allows a consistent modelling of national and region-specific economic development paths. The goal of this approach is a harmonization of the two levels, which means that information flows in both directions. The goal is not a simple "breaking down" of national developments at the regional level(s). The application of the approach raises certain challenges that must be overcome. We develop some preliminary solutions and highlight avenues for future research.

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Double Counting and Counter-Double Counting in Analysing the Value-Added Content of Bilateral Trade

Topic: (8.4) International Trade (3)

Author: Masaaki KUBONIWA

Abstract

In this paper, we explicitly demonstrate that we must consider not only double counting (subtraction) but also counter-double counting (addition) of foreign value-added contents to capture the value-added content of bilateral trade in the world with multiple production network. First, we present a theoretical schema to simultaneously track double counts and counter-double counts of foreign value-added contents in converting from conventional gross trade to value-added trade, based on Treffer-Zhu's bilateral definition of factor content of trade. This

schema shows that double counting (subtracting), which returns home as negative counts for bilateral trade, arises in the bilateral trade between a source/home country and its destination/partner country. It also shows that counter-double counting (adding), which returns home as positive counts for bilateral trade, occurs in trade between source or destination country and the third party countries, which is necessary to complete the bilateral trade. Second, we report empirical results by applying our schema to aggregated inter-country input-output data to capture value-added content of bilateral trade in the world with more than three countries. Our results exposes why a country's value-added trade with some destination can be greater or smaller than its gross trade or domestic value-added content, in a well-defined manner.

Reframing IO Analysis on Science, Technology & Innovation Policy: New Business Platforms generated from Intangible Capital Flow caused by R&D

Topic: (3.7) Techniques for Identifying Important I-O Coefficients and Sectors

Author: Masahiro KURODA

Co-Authors: YASUSHI HARA, Michael C. HUANG

The 21st century marks the internet of things (IoT) prosperity in cyber physical systems with the stream of technology change that drastically reshaped the social economy structure. The development of Information and Communication Technology (ICT) has made the physical input such as land, building or merchandise no longer necessary conditions for economic activities. Cases like UBER, AirBnB and other E-commerce have redesigned nowadays consumption style with sharp advice for the existing input-output (IO) analysis and its compilation. The paper aims to construct a recursive CGE model that illustrate the new business platforms reflecting the investment on R&D for facilitating capital service flow. The model is 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.

By reviewing the economic impact through examining several alternative policy options of government investment on science, technology and innovation, the deviations of economic structure could be captured from the changes of working hour, accumulation of tangible and non-tangible knowledge stock and wage ratio. The paper 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 data used in the model were sourced from Japan's IO table of 1995-2011 and was extended to distinguish 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. Furthermore, the paper decomposed the sectors of IO table into three categories: (1) Main product, (2) Intra-firm information management, and (3) R&D Activity. Under such disaggregation, we may acquire a systematic view of capital service flow facilitated by the ICT and IoT implementation for information allocation and processioning to accelerate its productivity for manufacturing.

In the mechanism of policy options, different level of processing efficiency index (P-index) in the activity divisions of marketing, planning, R&D, procurement, operation and sales, maintenance will be calibrated through a database system containing research grants, academic performance and patents. Also, the information management could benefit from outsourcing and externalization while the cross-sectional platform of information management may thus be

established. The simulation results showed the change on employment and production division along with the IoT/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 knowledge infrastructure that rose TFP. Finally, the increment revealed on human resource, higher level professional education, and mostly in the information, service and private R&D division sectors. The industrial evolution would increase the gap of knowledge that causes technological unemployment remains a concern, the analytical framework is expected to provide evidence-based approach for policy making system.

Green Growth in Zambia: SUT and Employment Projection Model for Zambia

Topic: (10.3) Input-output analysis for policy making (5)

Author: Massimiliano LA MARCA

Co-Authors: Marek Harsdorff, XIAO JIANG

The objective of the paper is to present: (i) an expanded SUT and SAM for Zambia including “Green Industries” in addition to the standard ISIC rev 4 industries, (ii) an “Employment projection model” based on the Zambian SAM to simulate conventional and green growth scenarios.

The detailed SAM featuring green industries will be based on a SUT recently assembled by the Central Statistics Office (CSO) Zambia. The detailed SUT and SAM tables will use the CSO 2010/2011 economic census for Zambia and ILO data.

The employment projection model will allow to compare conventional and green growth policies and to identify their employment impact over time. Such policy tool is not available to date and has been expressly requested by the Zambian Government to support its economic planning activity.

Changing Sectoral Patterns in China: a Structuralist Dynamic CGE Model

Topic: (7.7) Region/country-specific analysis (3)

Author: Massimiliano LA MARCA

Co-Authors: XIAO JIANG

China is undergoing a substantial structural transformation, with a decline in traditional industry and growth of higher skill manufactures and services. Average wages in China’s manufacturing sector have soared above those of countries like such as Brazil and Mexico (FT, 26 Feb. 2017). China has improved its living standard and working conditions after a rapid manufacturing expansion and allowing average hourly wage to appreciate. A rapid decline in the labor force growth is often considered as driving factor of the ongoing wage push.

According to national statistics, China’s service sector has surpassed the secondary sector and became the largest component of the GDP. In 2015, the share of the service sector in GDP rose by 2.4 percentage points in 2015, reaching 50.5%, 16.7 percentage points higher than the industrial sector. It is recognized that service sector could create favorable conditions for reducing overcapacity, and destocking and deleveraging, it would also facilitate the sector's transformation and upgrading and release huge demand potential. Meanwhile China's new

industries, new forms of business and new products took shape and grew more rapidly, and the added value of high-tech industries was up 10.2% year-on-year, growing much faster than traditional industries.

In 13th five-year plan (2016-2020), the government will target on increasing proportion of registered population in urban area to 45% to facilitate urbanization, which will release new demand and create huge potential for new supplies. It still poses the "biggest dividend" for China's transformation-based development.

The database construction, the model simulation and analysis will capture the trends and planned government interventions in the labor force composition (gender, skills/occupation, urban/rural workforce).

A SAM for China for the year 2012 is constructed based on Yang and Zhao (2010) approach based on four data sources Input-Output Tables, China Statistical Yearbook, China Labor Statistical Yearbook, and China Financial Statistical Yearbook. Given some changes in statistical scales and dimensions in the 2012 China financial statistical yearbook, some missing data are obtained via cross-entropy.

A structuralist simulation model (structuralist CGE) with differentiated adjustment mechanisms for agricultural, industrial and service sector is used to simulate the existing appreciation path and employment composition changes and identify policy scenarios that supports growth.

Subsystem analysis of the deindustrialization trends and their drivers in European countries

Topic: (6.6) Structural change and dynamics (2)

Author: Martin Lábaj

Co-Authors: Erika Stracová

Over the last decades, technological progress and reorganization of production activities across industries and national borders has led to an overall decline in employment and value added shares of manufacturing in advanced countries. After the recent economic crisis, policymakers across the globe called for an 'industrial renaissance' and took steps for a re-industrialization of their economies. On the other hand, outsourcing and continuous fragmentation of global value chains decrease the relevance of direct employment and value added effects of manufacturing for overall economic performance. Many activities, once taking part in manufacturing, are now supplied by businesses in the service sector and many high value added activities are being outsourced to companies outside the manufacturing industry. Thus, the analysis of deindustrialization processes calls for an approach that considers complex linkages among industries. Input-output analysis is a useful tool for capturing these indirect effects, which are not visible in simple statistics. The aim of the paper is to investigate the extent and the main drivers of the so-called deindustrialization in European countries over the last decades. The analysis is based on a subsystem perspective. It shows the proportion of the activity of each branch that comes under the individual subsystems. This allows us to reclassify any variable from a sector base into a subsystem base. For instance, it is possible to calculate the amount of labor required, both directly and indirectly, from sector i in order to satisfy the final demand in sector j . Several research questions are analyzed: Have the European countries become more deindustrialized considering both direct and indirect effects? Does the magnitude of the changes (direct vs. direct and indirect) differ? How did market services integrated into the manufacturing help to mitigate

the deindustrialization effects? Is manufacturing more integrated at the subsystem level? What was the role of international trade and 'tertiarization' in this process? The analysis is based on data from World Input-Output Database. The version released in 2013 covers the period from 1995 - 2011 including the socio-economic accounts with employment data. The new release from 2016 features data up to 2014 in a more detailed structure but socio-economic indicators linked to the data have not been published yet. So far, we can use the new release for the analysis of deindustrialization in terms of value added effects. The older data are used for the analysis of both value added and employment development.

Decomposition of Wage Inequalities in the World Economy: an Input-output Approach

Topic: (10.6) Structural Decomposition Analysis

Author: Martin Lábaj

Co-Authors: Paula Puskarova

Income and wealth inequalities, both between and within the advanced and developing countries, have attracted much attention in current economic debates. Wage inequalities appear to play a key role in the generation of final inequalities in terms of households' income, consumption and wealth. In this paper, we propose a decomposition approach based on the input-output analysis that allows us to disentangle the effects on the final inequalities' levels into the contributions of various determinants. So far, the analysis of income and wealth inequalities measured by standard inequality indices, e.g. Gini coefficient, Theil index, has received limited space in the input-output analysis. This does not imply that issues of income and wealth inequalities have been ignored in this stream of research. The focus of the input-output research has however been directed into different aspects of inequalities. In one way, researchers have put a lot of effort in the understanding how the income and wealth inequalities influence the structure of final demand of households, and eventually generate ambivalent effects on production, value added and employment. Other stream of research in input-output analysis has paid a lot of attention to inequalities that arise from the distribution of income that goes to labour and capital. We propose to calculate cross-industry and cross-country wage inequalities directly from the input-output tables, and analyze the final inequality variations through the lens of changes in the inputs. Detailed industry-level data on employees' wages linked to their hours worked and education attainments, which are covered by the World input-output database, allow us to illustrate the application of proposed methodology on major advanced and developing countries in the world. The analysis contributes to solving the puzzle around the impacts of human capital and technological progress on income inequality, but may shed also more light on the rising global inequalities unfolded by international trade and fragmentation of global value chains.

Self-consumption: An input-output analysis

Topic: (1.1) Energy Input-Output Modeling (1)

Author: Raquel Langarita

Co-Authors: Rosa DUARTE, Julio Sánchez Chóliz

The Spanish electricity system is characterized by a low competition and other managerial problems. One of these is the challenge of the implementation of the self-consumption, which supposes to approach the costs of the network use, the prices of repurchase and the structure of the network by itself. This will be the issue analysed here.

In a first step, from the supply and use tables for Spain for 2010, we have constructed a symmetric input-output (IO) table and a social accounting matrix (SAM). Moreover, taking into account the legal unbundling of the electricity sector (Spanish Electricity Industry Act 1997) and the existence of different technologies, we have disaggregated the energy sector of these tables into 10 sectors, named: Generation from wind, From nuclear, From conventional thermal, From hydropower, From solar and other types, Transmission, Distribution, Commercialization, Related activities to the electricity sector, and Gas.

Then, we want to address this question: is the promotion of self-consumption a good solution for improving sustainability? We study the scenario in which all sectors self-produce a part of their electricity consumption and the transmission and distribution costs are reduced.

To advance in this way, based on the information previously obtained, we modify the data of the different sectors to include a new scenario of self-consumption. We are mainly interested in the effect on both the electricity generation sectors and commercialization sector. We also want to investigate the possible alternatives for defining possible use and supply tables compatible with a symmetric IO table given.

Emissions embodied in international trade: an application to the French case

Topic: (4.1) Consumption-based accounts

Author: Gaëlle LE TREUT

Environmental progress achieved by a country depends on the scope given to the greenhouse gases (GHG) emissions inventory. In United Nations Framework Convention on Climate Change (UNFCCC) territorial-based inventories, the emissions embodied in international trade are not assessed while they warn about carbon leakage and represents a lever to understand competitiveness concerns. The assessment of emissions embodied in international trade is not straightforward and different methods exist to evaluate alternative emissions inventories. However, methods are data-intensive and models mainly rely on existing global databases with balanced bilateral trade flows. The control of these databases and the articulation with country-scale prospective models remain difficult.

We propose a single-region method to account CO₂ emissions with different perspectives of inventories, moving them from a production-based to a consumption-based point of view. To do so, the method also assesses emissions embodied by its external trade while taking into consideration major specificity of partner countries. Furthermore, for each inventories, sectors that drive emissions, and thus that represent a lever for environmental efforts, are identified. The technique relies on hybrid national-scale data to then be articulated with a prospective general equilibrium model.

The procedure is applied as a study case to France (2010) which energy transition law now provides for territorial emissions reduction targets without increasing embodied emissions in its imports. The results show that the differences between French CO₂ emission inventories, taking or not into account emissions embodied in international trade are not substantial. It also appears that if France had produced its own imports, it would have caused fewer CO₂ emissions. Finally, assessing different accounting system of CO₂ emissions lead to different sectoral distribution although results are sensitive to the level of initial description.

Pro-competitive effects of globalisation on prices, productivity and markups in the Euro Area

Topic: (3.3) International Trade (1)

Author: Raphael Seung-Ho Lee

Co-Authors: Mathilde PAK

Global trade has recently slowed down after a peak in the 1990s and early 2000s. Existing literature shows evidence of pro-competitive effects of trade liberalisation during this booming period on prices, productivity and markups. The goal of this paper is to assess whether such pro-competitive effects are still carried on in the manufacturing industry of five Euro Area countries (Austria, Germany, Spain, France and Italy).

Our analysis is based on Melitz and Ottaviano (2008) theoretical framework and its empirical setup by Chen et al (2004, 2009). Trade liberalisation is here assessed through import penetration in domestic markets and a larger market size, i.e. an increase in the number of firms. This would induce tougher competition. On the one hand, higher competition reduces markups by getting closer to the perfect competition. On the other hand, by a crowding-out effect, less productive firms exit the market and thus, average productivity goes up. Both effects result in a decline in the price level. The identification strategy is based on simultaneous equations in which productivity and markup are affected by imports penetration in final demand and the number of firms, and affect in turn prices. All three equations are estimated by an error correction model at industry level. Through this methodology, we can distinguish short- and long-term effects of trade openness and account for the productivity and mark-up channels affecting the price level.

The data used come from various datasets: BACH, Eurostat, OECD-STAN and WIOD. More specifically, BACH and Eurostat-SBS are used to get firms data like markups and the number of domestic firms. In a first step, we use OECD-STAN data to measure imports penetration in final demand. We can then directly compare our results with the existing literature on the same subject. In a second step, we use the update of World Input-Output Database (WIOD) through 2014 to build another value added imports penetration, based on Stehrer (2012) method.

The novelty of our paper is twofold. First, we carry out a sectoral analysis to shed light on sectors in which price competition is dominant over quality competition. Second, unlike the existing papers we consider global value chains (GVC), by measuring value added imports penetration in final demand. Since gross imports are recorded each time they cross borders, they include re-exported imports and can hence overstate their importance to competitiveness. In addition, the increasing importance of global value chains (GVC) has made the analysis of international trade more complex and traditional measures of trade are unable to take into account the full interdependence of markets and economies.

The comparison of the estimates from the estimation using the traditional measures and that using the value-added measures is striking. Our paper advocates the usage of value-added trade data in order to account for the global value chain.

Analysis on Economic Effects of Korean Procurement Policy for SMEs Using SMEs' Input-Output Table

Topic: (9.5) Input-output Analysis for Policy Making (4)

Author: Youngho LEE

Co-Authors: jaejin Kim, Jinmyon LEE

In Korea, public procurement schemes are implemented by Small and Medium Business Administration (SMBA) and Public Procurement Service (PPS). In particular, mandatory procurement for SMEs can encourage to increase the sale of SMEs to flourish the SME sector in Korea. Mandatory procurement for SMEs is the generic term for schemes to promote SMEs in public procurement provided by the government sector (governmental institutions, self-governing communities, and public organizations, provincial corporations, etc. as per Act on the Management of Public Institutions), defined by Article 2, Act on Facilitation of Purchase of Small and Medium Enterprise-Manufactured Products and Support for Development of their Markets.

SMBA announced that the share of SMEs in public procurement accounts for approximately 70%, and the public procurement provided by SMEs can exceed US\$ 72 billion, since implemented in 2006. Mandatory procurement for SMEs enable encourage the growth and development of SMEs, and thus, the paper utilized the IO table by firm sizes to measure the economic effect to SMEs in public procurement.

This study aims to analyze economic ripple effects induced from the mandatory procurement policy for SMEs such as the value-added and employment. The Korean SMEs' input-output table is applied to analyze the mandatory procurement policy for SMEs.

According to the result, the mandatory procurement for SMEs promotes to flourish SMEs and create the value-added and employment positively. Though this policy would be one of ways to vitalize SMEs, this study casts further research idea such as moral hazard related to the SME's status abuse to coincide with standards of mandatory procurement.

The Global MRIO Lab - final outcomes from Project Réunion

Topic: (8.7) Special Session: The Current State & Future plans of Global MRIO databases (1)

Author: Manfred LENZEN

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(1) There has been ample experience with constructing large-scale global MRIO tables within a number of institutions or consortia. However, these undertakings have been impeded by their high financial resource requirements, resulting in infrequent or untimely database updates, or discontinuation of time series. In order to be relevant for international policy, global MRIO databases need to be created and updated in a timely, continuous, consistent, and cost-effective way.

(2) These issues can in principle be addressed by instigating a collaboration between the various global MRIO teams. This idea was first discussed at a meeting at L'Hermitage-les-Bains on Réunion Island in March 2011, by participants of the Project Réunion, from TNO Delft/CML Leiden, the University of Groningen, the OECD, Purdue University, the Japan External Trade Organisation, the Center for International Climate and Environmental Research in Oslo, and the University of Sydney. The goal of Project Réunion was to coordinate worldwide activities on

environmentally-extended MRIO database compilation.

(3) As a first step, Project Réunion members agreed, in their 2013 meeting at Kurokawa Onsen, to aim at demonstrating the ability to generate, based on unified data pools and construction pipelines, a set of global MRIO databases expressed in the regional and sectoral classifications of the EXIOBASE, WIOD and Eora tables. In 2013, Project Réunion received funding from the Australian Research Council, and work started on realising the collaboration using virtual laboratory technology.

(4) This presentation deals with the global expansion of the Australian IELab archetype into a global virtual laboratory for Project Réunion participants. I will explain the concept, architecture, and development of the Global MRIO Lab, with particular focus on a few technical aspects in which the global lab differs from its Australian predecessor, and which had to be solved within the scope of Project Réunion. I will describe some first concrete outcomes of Project Réunion, with the aim of demonstrating how the virtual laboratory's concept and technical innovations enable researchers to create world MRIO databases in a flexible way. I will report on reflections on Project Réunion's journey, and an outlook for the future.

Products from Recovered Wastes as a Technological Option: The Waste Input-Output Model with a Choice among Technologies

Topic: (4.4) Special Session: Building a Circular Economy: Assessing the Sustainability of New Technologies for Material Recovery and Waste Cycling

Author: Stephen Harris Levine

Co-Authors: Faye DUCHIN

Products from Recovered Wastes as a Technological Option: The Waste Input-Output Model with a Choice among Technologies

Authors: F. Duchin and S.H. Levine

Presenter: S.H. Levine

Abstract. The Rectangular-Choice-of-Technology Model (RCOT) [Duchin and Levine, 2011] is a constrained optimization model that has been applied in a number of empirical studies to select relatively low-cost production options subject to factor and other constraints within an input-output framework. One example is [López-Morales and Duchin, 2015], with agricultural options of rainfed production or irrigation from surface water sources or groundwater. The Waste Input-Output (WIO) model [Nakamura and Kondo, 2002] has likewise been applied in a number of empirical investigations to quantify, for example, the flows of metals in the Japanese economy [Nakamura and Nakajima, 2005]. Our purpose in this presentation is to integrate the two frameworks into the WIO/RCOT model that provides producers of a given product with choices among technologies that depend on virgin ores and ones that rely instead on a variety of recovered materials. This paper describes the integrated conceptual framework and applies it to illustrative numerical examples focusing on alternative technologies for producing computers. The baseline technology relies on mined materials, one alternative makes use instead of recycled materials, and another refurbishes existing computers. We examine the physical impacts of several sets of scenario assumptions compared to the baseline case, such as changes in output of the mining sector, in employment, and in landfill requirements, as well as differences in costs of production and in prices of computers and of other goods. We conclude by describing scenarios that would merit a full-scale empirical investigation.

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The Decomposition Analysis of China Provincial Energy Demand Based on Revised Provincial IO Tables

Topic:

Author: Jifeng Li

Co-Authors: Yaxiong ZHANG

The driving force of energy demands in different provinces is quite different from each other. From demand side, for some provinces, the energy demands come from the increase of capital investment, like Shandong, Tianjin, etc. for other provinces, the energy demands are driven by outflow to other provinces and export to other countries.

However, for the 30 original provincial IO tables of 2012 from NBS, there are big discrepancies for each product between total inflow and outflow of all provinces. In this study, we try to compromise the total inflow and outflow for each provincial IO table based on building the trade flow matrix, and then decompose the energy demand for the contribution of domestic consumption, domestic investment, outflow and export.

Anatomy of China's carbon dioxide emission: the role of induced and autonomous consumptions

Topic: (3.1) Methodological Aspects of IO Analysis (1)

Author: Jing LI

Co-Authors: Chen LIN

Anthropogenic greenhouse gas (GHG) emissions have been increasing globally since the pre-industrial era, driven largely by economic growth (IPCC, 2014a). Modeling consumption change under the background of economic growth is central to GHG projection models (Lenzen, 1998; Peters and Hertwich, 2008; Hertwich and Peters, 2009; Davis and Caldeira, 2010). With respect to income, consumption is either induced or autonomous. The former is influenced by income level, while the latter is independent of disposable income (Keynes, 1936). Because the induced consumption is more elastic on income and more sensitive on policies, it is important to differentiate these two types of consumption in analytical and projection models for CO₂ mitigation. However, few studies make this distinction. Here, we decompose the driving factors of China's CO₂ emission by considering the two consumptions in a comprehensive multi-sectoral model. Our projection model based on the decomposition analysis shows that (1) Baseline scenario that estimated induced consumption conservatively will over-estimate China's CO₂ emission; (2) Policy arrangement focusing on induced consumption can mitigate GHG emission efficiently.

The evolution of China's economic structure—An Analysis Based on the 1987 through 2012 IO Tables

Topic: (1.2) Special Session: Input-output approach and impacts of economic policy in the emerging markets (1)

Author: Shantong LI

Co-Authors: Jianwu HE

China's economy is undergoing a significant transformation in recent years. Many aspects of the economic structure shows different trends, comparing with that in last three decades. Traditional engine of growth faces a severe challenge.

First, China's growth rate had stepped down, dropping from 10% before international financial crisis to 6-7% in recent years. Many projections show the prospect of economy will turn more terrible and dismal. Second, the annual growth rate of exports goes down from about 20% before the 2008 international financial crisis to negative in recent two years. Meanwhile there exists notable adjustment in the structure of exports. Third, there is a turnaround in the growth of investment and investment rate. From 2011, investment rate has begun to decline, from 48% (the peak in last three decades) in 2011 to 45% in 2015. Finally, China is experiencing major changes in the economic structure. Service sector displaced the secondary industry as the biggest sector in 2012. China's economy is moving from an economy dominated by manufacturing to one where services play a major role.

All these measures are indicators of changes occurring in the structure of the economy, but they do not tell us fully where or why those changes are occurring. Input-output analysis allows us to study these structural changes in the economy. It provides the tools necessary to evaluate industries, including their relationships to the rest of the economy and the effects of international trade on those relationships. In this paper, we analyze structural changes in the China's economy and the role of supply and demand on those changes. For this analysis, we use six input-output tables from 1987 through 2012 prepared before and after international financial crisis.

Key Words: Structural Change of Economy; I/O Analysis

Outline:

1. Introduction
2. The key features of China's economic structure change
3. Data and methodology
4. The main result of analysis
5. Conclusion and policy implication

Analyzing the Changes in China's Final-demand-driven Environmental Emissions with an Input-output based Structural Decomposition Analysis

Topic: (10.6) Structural Decomposition Analysis

Author: Qiao-Mei Liang

Co-Authors: Li-Jing Liu

Abstract: Assessing the environmental emissions driven by final demands is critical to realize a

more sustainable and fundamental mitigation. In view of this, this study focused on the total emissions driven by one unit increase of different final products, i.e., emission multiplier. This study performed an input-output based structural decomposition analysis about the changes in COD, ammonia nitrogen, SO₂, NO_x, soot and dust, industrial solid waste and CO₂ emission multipliers for 41 final products during 2007-2012 in China. The main data required here include the input-output tables and environmental emissions statistics. Results show that during the examined period the emission multipliers were in general decreasing. The main contributor to this phenomena was technical effect, i.e., reduction of emissions per unit output. An important feature of the technical effect in this period was that the technical factors that had significant contributions were concentrated in only eight sectors. Moreover, the technology effect in this period presented obvious spillover effect. Although the contribution of structural factors was far less good as the technical factors, there were still some structural adjustments that had led to significant synergistic mitigation effects. However, the NO_x and/or CO₂ multipliers of some final products increased during this period. In addition, although most of the technical effects in this period were with high efficiency, four factors were identified which could be efficient but were with small contributions. The problem of structural effect was more prominent: most of the structural factors with high efficiency were with small contributions; more than 1/3 of the structure effect that were with obvious contributions played positive roles. This study contributed to the existing studies by performing a detailed sector-level structural decomposition analysis, adopting the demand-side indicators to describe environmental quality, and considering multiple environmental discharges simultaneously.

Keywords: emission multiplier; input-output; structural decomposition analysis; China

Inertia in the Evolution of Carbon Emission of China

Topic: (10.1) Emerging developing countries

Author: Chen LIN

Co-Authors: Jing LI

This paper diagnoses the carbon emission problems of China from 1957 to 2012 from the structural perspective by using the newly compiled Chinese historical input-output tables (CHIOTs). The tables include 161 commodities, 18 industries, and sectoral CO₂ emission, which support the analysis of historical carbon emission in high degree of resolution. The results shows that the hot-spot and structure of carbon emission are relatively stable across more than half a century. This is because China has a full size economy covering all types of industries since 1950s. From the first five-years plan, China tried to build a whole industrial chain due to the "independent policy" for both economic and national defense safety. This makes the inter-industrial relation with respect to both material flow and carbon footprint be relatively stable. Meanwhile, we also observe an inertia effect such that an industry's energy structure is stable due to technology inertia. Therefore, for China, a country with the whole industrial chain, it is not easy to mitigate carbon emission by industrial transfer or upgrade (i.e. carbon leakage). The most effective way is to increase the energy efficiency of each sector.

One sows and another reaps: the impact of heavy industry strategy on the technology selection after the economic reform of China

Topic: (6.6) Structural change and dynamics (2)

Author: Chen LIN

This paper uses the newly compiled Chinese historical input output tables (CHIOTs) 1957-1973 and a multi-sectoral model to rationalize the rapid technology introduction and economic growth after economic reform. D. Licardo argued that the introduction of new technology/machines needs condition that makes the introduction of new technology/machines profitable. The condition is decided by the accumulation of capital and labors. This study shows that the heavy industry strategy in the pre-economic reform era accelerated the capital accumulation and made the introduction of new technology of the light industry more profitable. This finally speeded up the economic growth of China. This study is based on the CHIOTs, which provides inter-industrial data for the years before economic reform of China in high degree of resolution.

Value Added Trade and Resource Curse Thesis

Topic: (9.5) Input-output Analysis for Policy Making (4)

Author: Shih-mo LIN

Co-Authors: Kuei-Feng Chang, Jin-Xu Lin

This paper revisits the resource curse thesis from the recent perspective of value added trade. The negative relationship between natural resource dependence and economic growth has been found in many resource-abundant economies, and the possible causes of this relationship have been proposed and examined extensively in the literature. One of the reasons causing slower economic growth in resource-abundant economies is that production factors tend to shift from producing manufacturing goods to producing resource ones. And even worse is that some of the factor revenues are collected by foreign-owned companies and the consumption tends to shift from domestic goods to imported ones. This paper tries to examine whether the resource curse phenomenon is existing in resource-rich economies and investigates the possible causes associated with different types of economies from the value added trade perspective. Our results could provide another view on resource curse thesis and figure out which economies are having the tendency of getting the curse.

What Are Impacts of Waste Treatment Option on Green Products' Prices by Sector?

Topic: (8.3) Environmental IO Modelling (5)

Author: Xiuli LIU

This paper established a framework of Waste treatment Input-Occupancy-Output (IOO) table which integrated the environment and economic costs of waste treatments with the normal IO model. Based on it, an innovative model to calculate price change rate of green products by sector compared with their basic price (it was assumed to be 1 for each sector) in 3 scenarios was established. The model was applied in sewage treatment case in China, price change rates of 51 sectors in 3 scenarios were evaluated. The input-output table of China as a base was published by China Statistical Bureau. The treatment cost for sewage of secondary industry was from China

Statistical YearBook, the data of the other industries was cited from Tan et al. (2015). The results showed that, the price increase rate of Chemicals, Metal smelting and pressing and Electricity, steam and hot water production and supply (excluding hydroelectric power) ranked top 3. The price increase of 43 sectors were mainly caused by other sectors' added sewage treatment cost. The results in 3 scenarios were compared, the producers and the administrative organizations were suggested to pay charges for disposing sewage to make production which could bring more price advantage for green products.

Carbon footprint of human settlements in Spain

Topic: (4.1) Consumption-based accounts

Author: Luis A. LOPEZ

Co-Authors: Guadalupe Arce, Maria A. Tobarra-Gomez, Jorge E. Zafrilla

The role of towns and their inhabitants in fighting climate change is becoming increasingly important (Shi et al., 2016). In this context, the aim of this paper is to apply a multi-regional input-output model to study the evolution of the carbon footprint for Spanish households as determined by the different type of settlement. This study analyses the household carbon footprint as a function of the municipality's population size, whether it is located in a rural or urban environment, and its relation to population density. By using a multi-regional model we are able to calculate the share of that carbon footprint that is generated within the settlement and the share that is produced around the world along global value chains. This methodology has been widely applied to study carbon footprints for households in terms of different characteristics: income levels (Duarte, Mainar & Sánchez-Chóliz, 2012), age (Shigetomi, Nansai, Kagawa & Tohno, 2014), consumption of agriculture products (López, Cadarso, Gómez & Tobarra, 2015), or tourism consumption (Cadarso, Gómez, López & Tobarra, 2015).

The structure of household consumption as a function of the type of settlement will be used to analyse whether socio-economic features are the greatest influence in the level of carbon footprint, or by the contrary, structural, institutional or geographical factors of the settlement are more relevant. Previous literature has addressed this link in other countries, for instance Fan, Guo, Marinova, Wu & Zhao (2012), Jan et al. (2013), Baiocchi, Creutzig, Minx & Pichler (2015) or Ahmad, Baiocchi & Creutzig (2015), but not for the Spanish case.

Regarding data sources, we propose combining the World Input-Output Database (WIOD) and the Household Budget Survey for the Spanish economy, in order to analyse the carbon footprint from household consumption for the period 2006-2014.

In terms of carbon footprint from goods' purchasing, our analysis leads us to conclude that the geographical, structural or institutional factors have a moderate impact, as the carbon footprint increases slightly with population size and density. Higher income levels in bigger and densely populated municipalities explains this growth, as it overcomes the lower emissions per euro as the emissions intensity is lower than in rural areas. Consumption of electricity and gas has the largest share in this carbon footprint, either directly by households or indirectly by means of the required electricity to produce goods and services. Nevertheless, when we compare our results to previous findings, we can conclude that socioeconomic features (income distribution, age of the head of the household, household size) have more importance on total carbon footprint.

Economic Impact of the New Mediterranean Rail Corridor in Andalusia: A Dynamic CGE Approach

Topic: (1.4) CGE Modelling (1)

Author: Roberto LOPEZ

Co-Authors: Manuel A. CARDENETE

The transport sector is the life blood of the economy and serve as engine that fuels economic growth. From this perspective, the European Union is favoring the improvement of communications all around Europe. The goal is to create a European net of transports (TEN-T), and in this net the port of Algeciras in the strait of Gibraltar is an important node, as a primary rail hub for both the Mediterranean and Atlantic TEN-T rail corridors of the European Core Network. This paper assesses the impact of this new infrastructure in the economy of Andalusia through the use of a Computational General Equilibrium (CGE) model. The CGE will also add a dynamic component to evaluate the effect along several periods of time, based on the growth model of Ramsey with a representative consumer with infinite lifetime. The calibration of the model is done with the Social Accounting Matrix (SAM) of Andalusia of 2010 where the different modes of transport have been previously disaggregated. This work evaluates the long-term impact of the new rail infrastructure in the port of Algeciras, in terms of an increase of the traffic and also the shift from the road transport to the train. This work, however, is not taking into account other effects such as the impact of the construction of the infrastructures, neither the effect of the attractiveness of the area to the installation of new industries. Although impact analysis has been previously applied to assess the impact of transport infrastructures in Spain, these have made use of linear models, which underlay assumptions that are very restrictive. CGE models shifts these limitations, providing more realistic values; therefore, this work fill in this gap by introducing a Dynamic CGE model that overcome some of the limitations of linear models.

On the economic analysis of wastewater generation and treatment: the Mexican case

Topic: (4.4) Special Session: Building a Circular Economy: Assessing the Sustainability of New Technologies for Material Recovery and Waste Cycling

Author: Carlos A Lopez-Morales

[Note this is an abstract presented to the Special Session "Building a Circular Economy: Assessing the Sustainability of New Technologies for Material Recovery and Waste Cycling" organized by Nathaniel Springer]

Like many other developing countries, Mexico's appropriation of water is used mainly to irrigate agricultural fields, with 77% of total yearly withdrawals, while industrial and household uses account for the rest. Production of wastewater, then, is divided between diffusive agricultural runoff, usually not accounted for in official statistics, and point generation of industrial and household flows, which are classified as municipal flows for urban centers and non-municipal for industries located in non-urban locations. The capacity for water treatment in Mexico has been increasing steadily over the last decade, but it is still clearly insufficient: at least 40% of the combined municipal and non-municipal wastewater production goes back to waterways untreated, while agricultural runoff, which contributes with the largest volumes to wastewater, does not receive special treatment at all, in part due to its diffuse nature. To ameliorate the associated degradation of water ecosystems, the risks to public health, and the contribution to water scarcity altogether, the Mexican government is investing US\$ 1B to bring online two

massive treatment plants located in two of the most compromised water basins in the country.

This paper makes use of an existing model and database for thirteen hydro-economic regions of the Mexican economy (López-Morales and Duchin, 2015) to incorporate wastewater treatment activities into the World Trade Model with Rectangular Choice of Technologies (WTM/RCOT, Duchin and Levine 2012). This approach builds upon a recent implementation of the WTM/RCOT for water treatment in the global economy (Cazcarro et al. 2015), and describes its relationships with associated literature, including Leontief (1970), Duchin (1985), and Nakamura and Kondo (2002). In particular, the work by Cazcarro et al. (2015) estimated the global economic costs of treating different volumes of wastewater set exogenously to the model, while the present study aims at estimating them endogenously by establishing the actual physical capacities of existing and of new treatment plants. Two scenarios are designed for comparison purposes: a Baseline with the existing nation-wide treatment capacity and a Policy scenario, in which treatment capacities for the regional economies installing the new plants are expanded. The relaxation of treatment constraints in these regions produces economic gains due to reduced pollution, scarcity, and water withdrawals, and the exercise compares these to the construction costs.

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The 2016 Release of the World Input-Output Database

Topic: (8.7) Special Session: The Current State & Future plans of Global MRIO databases (1)

Author: Bart LOS

In November 2016, a new release of the World Input-Output Database (WIOD) was released. The data in this release cover the period 2000-2014, and more industry detail could be incorporated. The construction methodology is largely comparable to the construction procedures for the 2013 release (discussed in Dietzenbacher et al., 2013, ESR), but some features are different. Many of the differences relate to changes in the extent and nature of the available official and freely available source data, while a few additional changes are the consequence of improvements in the construction procedure itself. In this presentation, some of the differences will be explained, and a few empirical comparisons regarding key indicators derived from the 2013 and 2016 releases (for years present in both series) will be discussed.

Construction of a Time Series of NUTS2 Regional Input-Output Tables for the EU Embedded in Global Input-Output Tables

Topic: (8.7) Special Session: The Current State & Future plans of Global MRIO databases (1)

Author: Bart LOS

Co-Authors: Mark Thissen, Maureen Lankhuizen

Already before the relatively recent surge in the availability of global input-output tables to study the structures of value chains and the role countries play in these, the case study-based literature on the emergence of global value chains (GVCs) acknowledged the opportunities and threats posed by these GVCs for the prosperity of regions defined at the subnational level. Some input-output researchers have integrated official data at regional level for one specific country with global input-output tables (we know of such attempts for Brazil, China and Italy). In this presentation, we will present a novel database that incorporates data from Eurostat's regional statistics, survey-based regional supply and use tables/input-output tables, transportation data and the World Input-Output Database (WIOD, 2013 release) and presents global input-output tables with regional detail (at NUTS2 level) for almost all EU countries. The data is available for the period 2000-2010. Attention will be paid to some of the most important strengths and weaknesses of the construction procedure, and empirical results for several indicators of regional GVC participation will be discussed.

Improving IOT updates with Bayesian methodology

Topic: (8.2) Methodological Aspects of Input-Output Analysis (3)

Author: Oleg LUGOVOY

Co-Authors: Andrey POLBIN, Vladimir POTASHNIKOV

The paper continues the authors' efforts on developing and application of 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. 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 IOT coefficients.

In the paper with provide multiple tests of the developed techniques and discuss ways of increasing precision and performance of the method. The examples include updating official IOTs for United States, China, Russia, and date from WIOD – database, but based on benchmark years only. The analysis suggests approaches for improving estimates, i.e. reducing prediction error and narrowing confidence intervals estimates, based specification of priors with and without additional information, as well as combination with other (mainstream) updating methods.

Cost and Benefits of Deep Decarbonization in Russia: a Thought Experiment

Topic: (10.5) Methodological Aspects of IO Analysis (4)

Author: Oleg LUGOVOY

Co-Authors: John Alan Laitner, Andrey POLBIN, Vladimir POTASHNIKOV

With the new Paris climate agreement, 195 nations have committed to lower planet-warming greenhouse gas emissions and limit global temperature growth within 2C, with a target 1.5C. This goal requires every country to radically cut their emissions, deeply decarbonize their economies, i.e. rebuild both energy supply and use sectors. Even bigger challenges meet natural resources exporting countries, which have also find new sources for growth to replace revenues from energy export.

The overall economic impact of the transformation is hard to quantify. From one hand, the decarbonization requires higher upfront investments in energy efficiency and alternative energy, which can be considered as a burden on the economy. From other hand, the additional investments in infrastructure can considered as a stimulating driver for an economy, which also brings energy savings in the future. Third, the transformation affects economy structure, slowing down fossil energy production, substituting energy consumptions with higher demand for manufacturing products, construction, and R&D.

In the paper, we propose a “Thought experiment” of economic impact of decarbonization, with quantification on input-output table for Russia. As participants of Deep Decarbonization Pathways Project (DDPP), the authors use results of the modeled DDPP scenario as an input to an IOT-analysis, estimating the impact of low carbon scenario on economy. We apply stochastically estimated IOT for Russia to estimate potential uncertainty in data and the overall outcome of the considered effect.

According to the results, the positive effects of decarbonization strategies can overcome negative in both short- and long-terms, and additional effects are fully consistent with officially announced long-term goals of modernization and reducing the Russian economy’s dependence on energy and raw-materials exports.

Estimating nationwide impacts using an input-output model with fuzzy parameters

Topic: (6.5) Methodological aspects of IO analysis (2)

Author: Ganna Makarkina

Co-Authors: Michael L LAHR

Abstract. A oft-forgotten feature of input-output models (IO models) is the inherent incompleteness and inaccuracy of the underlying survey data that are used to build them. Many different techniques have been applied to resolve these data issues. Here we introduce an approach based on the fuzzy set theory. To do so, we articulate the lack of reliability of technical coefficient values, assuming the qualities themselves are equivalently expressed as a finite set of discrete values. The discrete values reflect domains coefficient sizes. The domains are defined by quantitative (membership) functions—quasi-probability density membership functions—that parallel density functions of “true” cell values. The relative sizes of the domains of the fuzzy components suggest the relative reliabilities when bi-proportionally adjusting the I-O accounts, given known exogenous factors. The membership functions enable the use of a quasi-stochastic programming model to estimate fuzzy impacts of changes in final demand. Results of the fuzzy model are compared to results estimated via classically created IO model.

In this paper, we estimate impact of different elements of the final demand on the US economy. Gaussian membership functions are employed to describe the technical coefficients. The domains for the functions are defined via cluster analyses of data in the US Make and Use tables. The impacts derived from both absolute and relative changes in the final demand for separate industries and the group of independent industries on the gross output for 60 industries of the national economy are subsequently estimated via I-O model with the fuzzy matrix of technical coefficients.

We next extend the initial model by also fuzzifying different components of final demand: investment and international trade flows. After adding fuzzified versions of these components of national accounts, the technical coefficients are even further fuzzified. The known final demands on the US economy are re-estimated, now with fuzzified technical coefficients, investment, and trade. We still find the estimated difference between the fuzzy and classical results to be fairly small; this suggests that the fuzzy approach may be a promising way to update and reconcile input-output data.

An interregional impact analysis of the EU Cohesion Policy in the EU 28

Topic: (3.2) Impact Analysis: Multipliers (1)

Author: Giovanni MANDRAS

This paper evaluates the likely economic effects of EU Cohesion Policy in the EU 28. The EU cohesion policy (ECP) has seven-year budget that in the current programming period (2014-2020) amounts to € 340 billion, corresponding to around 2% of total EU GDP 28.

ECP makes use of some financial instruments with the aim of reducing disparities in economic development among European regions attempting to achieve a strengthening of economic, social and territorial cohesion. In particular, regional disparities are interpreted mainly in terms of regional income per capita and rates of unemployment.

National/Regional governments are required to use these resources and to co-finance the investments made by the funds. The general objectives of the actions promoted by this policy are those of the convergence of GDP between regions, the raising of competitiveness and employment, and a greater cooperation between neighbouring territories. More specifically, with respect to the previous programming period, EU aims to modernise the use of funds of the CP and to align as much as possible the distribution of regional resources to the objectives of the Europe 2020 'strategy; a more sustainable economic growth. We consider several scenarios reflecting the different budget lines of Cohesion.

The analysis is performed by using a large-scale inter-regional input output (IRIO) model in order to explore the inter-regional effects of the ECP in terms of output, value added and employment. This analysis offers additional information on inter-regional spillovers and on the share of output effects that are captured by the richest/poorest regions through their intersectoral linkages.

The IRIO model used consists of 268 regions (NUTS2 classification) of the 28 EU countries and the reference year is 2013. The model's database consists of the regionalised supply and use tables provided by Eurostat and of an ad hoc estimated inter-regional trade matrix.

Key words: interregional input-output model; interregional trade; EU Cohesion Policy

The impact of unemployment: Crisis escalation in the Greek Economy

Topic: (5.2) Input-output analysis for policy making (2)

Author: Maria Markaki

Co-Authors: Athena Belegri-Roboli, George Kritikides, Theocharis Marinos

The purpose of our research is to investigate the relation between unemployment and economic crisis both in an economy and with regard its trade partners. We investigate how the unemployment of former employees' in Greece during the period 2008-2014 conduced to the deepening of this crisis and the effects of this unemployment to Greece's EU trade partners. In other words, we estimate how the decreased demand for final products, that occurred due to the former employees' unemployment caused firstly the country's direct and indirect production decrease and secondly, to the economy's commercial partners.

The application of Input-Output Analysis allows us to estimate the total multiplier effects in production, due to a shift in the final demand (in our research we locate three distinct shift in final demand: decrease of domestic final demand, decrease of imports for household consumption, decrease of imports for intermediate use). For our analysis we use the input-output table of the Greek economy and the input-output table of its main trade partners, data for unemployment and income by sector of economic activity and the distribution of the households' final demand for domestic and imported goods and services.

The main results of the study per unemployed person indicates that:

- The yearly demand reduction for domestically produced goods and services is estimated at 7,612 € and the production decrease of the Greek economy at 10,837 €, respectively.
- The yearly demand reduction for imports, aiming to cover households' consuming needs, is estimated at 1,240 € and the production decrease to third countries at 2,263 €, respectively.
- The yearly demand reduction for intermediate goods and services is estimated at 750 € and the production decrease to third countries at 896 €, respectively.

The results shows that a significant part of the production loss and, hence, the crisis escalation, starts from the size of unemployment but, also, the structural defects of the Greek economy. This significant production loss not only constitutes a strong disorder to the economic loop (product - income - expenditure) but, also, highlights the need for the public policies' revision.

A New Test of Economy-wide Factor Mobility

Topic: (7.1) Mathematical Treatments of Input-Output Relationships

Author: Kathryn Gail Marshall

Co-Authors: Eric Fisher

A long-standing debate in international trade is the degree to which various factors of production, such as skilled and unskilled labor and capital, are industry-specific or are free to move between sectors. If factors are specific to industries, one would expect to find substantial differences in factor returns across industries. If they are mobile between sectors, one would expect to find similar factor returns across industries. The degree of factor mobility has huge implications for how the benefits of trade are distributed, and it is the basis for a large theoretical and empirical literature on the political economy of trade. The implication of inter-industry factor price equalization extends well beyond debates on the impact of international trade, informing Baumol's famous cost disease argument that productivity growth in manufacturing will raise wages and hence costs in service sectors.

This paper constructs a simple Wald test based upon the hypothesis that all factors of production are mobile between sectors. We evaluate the hypothesis using consistent data from the World Input-Output Database that covers 35 industries and up to 4 factors in 40 countries. The null hypothesis of frictionless factor markets cannot be rejected in 24 countries in the benchmark year 2005 for two factors, labor and capital. We also evaluate a breakdown of skilled and unskilled labor based on college educations. In 19 countries we cannot reject the null hypothesis of factor mobility at this more dis-aggregated level. In those 16 countries in which labor and capital are immobile, we show substantial distortions reflected in excess earnings by either labor or capital, depending on the country.

The EU Inter-country Supply, Use and Input-Output Tables (FIGARO Project): recent progress

Topic: (10.2) Special Session: The Current State & Future plans of Global MRIO databases (2)

Author: Pedro MARTINS FERREIRA

Co-Authors: Isabelle REMOND-TIEDREZ, José M. RUEDA-CANTUCHE

The Eurostat-JRC project "Full International and Global Accounts for Research in Input-Output Analysis" (FIGARO) aims to produce experimental EU-Inter Country Supply, Use and Input-Output Tables for the year 2010 in line with the ESA 2010 methodology. From the experience gained in the project, a statistical production process will be designed so that Eurostat can start publishing these types of tables on a regular basis.

The project also has an institutional perspective by setting up consistent tables, recognised by international agencies such as the OECD, UNSD and the National Statistical Offices of the EU Member States, all of which participate in the discussions on the consistency between national trade data and international trade databases.

Besides the construction of the EU Inter-country Supply, Use and Input-Output Tables, the project also covers links to employment, capital and environmental accounts (in particular, air emission accounts, material flow accounts and energy accounts); and to the work of the OECD Expert Group on Extended supply and Use Tables.

This presentation is about the state of the art of the project, with a particular focus on the decisions made regarding the methodological issues raised by the construction process of the Inter-country Supply, Use and Input-Output Tables: e.g. econometric estimations of cif/fob margins; econometric estimations of missing bilateral services trade; alignment of trade statistics and national accounts data: e.g. goods sent abroad for processing, merchanting activities...

Estimating Balanced Detailed SUT Using Benchmark SUT

Topic: (9.4) Special Session: From USA national Supply, Use and Input-Output compilation to European standards

Author: Pedro MARTINS FERREIRA

Given an aggregate set of balanced supply and use tables (SUT) and a set of more detailed SUT, e.g. for a different time period where more detailed data is available, that could be used to breakdown the aggregated SUT into more detailed ones, the outcome would be unbalanced detailed SUT. This paper proposes a balancing procedure to breakdown balanced aggregated SUT

into balanced detailed ones, which was specifically developed to convert US SUT in NAICS to (CPA/NACE), making them comparable with EU tables. However, the method can be applied to any case where aggregated tables are to be broken-down to more detailed ones using as a reference detailed tables from a different time period or different economic area. The procedure follows a GRAS-type of approach, having an inner loop, which makes at each that at every k steps the estimated detailed SUT, and an outer loop, making the procedure flexible regarding SUT margins constraints, i.e. total supply / total use and output derived from supply table / output derived from use table. The results of this method applied to the US SUT tables will be presented.

Degree of Dependence on Imports of the Automotive Cluster and the Economic Effects on Manufacturing in the Northeastern Region of Mexico: A Bottom-up Methodological and Analytical Approach

Topic: (10.7) Regional input-output modeling (2)

Author: Marcos N. MAYA

Co-Authors: José Manuel Sánchez Gamboa, Normand Asuad Sanen

Economically, the automotive industry is very important for being a promoter of national exports and for the productive variety of companies that integrate its supply chain. If this industry is linked to the activities of its regional surroundings, multiplier effects will be transmitted to other local manufacturing branches and irradiated to other sub-regions and thus contributing for its development, otherwise, if this industry is not chained, its impact on the growth of other industries and sub-regions will be halted and there will be dependence on imports. Analyzing this industry through its sectoral interactions at a sub-regional level, allows the identification of its economic-spatial impacts, using as an analytical tool a regional input-output matrix, constructed under a bottom-up approach.

In Mexico, a notorious case is the Northeast region, which in 2008 concentrated 23% of value added and 20% of employment of the national automotive industry. This activity is spatially concentrated in a corridor that includes two functional sub-regions located around the metropolitan areas of Saltillo and Monterrey (Maya, Asuad and Sánchez, 2016).

This research comes from the following basic question:

What is the degree of dependence on imports of the automotive cluster and the regional economic impact on the manufacturing sector at a sub-regional level in the Northeast region of Mexico?

The main purpose of this work is to identify at a sub-regional level, whether there is an inter- and intra subregional dragging effect of the automotive cluster in the manufacturing branches or, on the other hand if an enclave economy exists, characterized by a large share of value added from imports.

The methodology used consists mainly of three parts: 1) Construction of a multi-subregional matrix by using branches of the manufacturing industry under a bottom up approach (Asuad and Sánchez, 2016); 2) Analysis of principal components to identify manufacturing clusters, including the automotive industry (Feser and Bergman, 2000); and 3) Characterization of the linkage between the automotive cluster and the regional manufacturing industry (Schuschuny, 2005), by reviewing the degree of dependence on imports, through the vertical specialization method. (Maya, Asuad and Sánchez, 2015).

The data used come mainly from INEGI's 2014 Economic Censuses, which record the activity of industrial manufacturing establishments. However, the regional industrial accounts were validated considering the information of the economic accounts by both state and national levels. Unlike previous studies related to the automotive industry in Northeast Mexico, this paper highlights the importance of considering buying and selling relationships between sub-regions, as

well as characterizing their manufacturing chains with the automotive industry based on an input-output analysis, using regional data.

The Right Tax? Macroeconomic and Industry Impacts of Proposed U.S. Tax Reform

Topic: (2.7) Input-output analysis for policy making (1)

Author: Douglas S. MEADE

On June 24, 2016, House Republicans released a 35-page report on tax reform that would lower the corporate tax rate to 20 percent, provide full expensing for business investments, eliminate the deduction for net business interest expense, eliminate most tax preferences, and exempt active foreign business income under a ‘territorial’ system. The plan also includes border adjustments that would exempt export receipts and deny a deduction for import costs, following a destination-based approach to tax jurisdiction. Overall, the “Blueprint” is a type of destination-based business cash flow tax (DBCFT). In addition, the proposed reform allows for immediate expensing of investments, unless the investment components were imported. The proposed tax system is expected to have wide-ranging and varying effects on prices, real wages and the exchange rate.

In this study, we use the Inforum Lift model of the U.S. to examine the effects of this proposed tax reform on taxes paid, prices, output and employment by industry. Lift is a dynamic econometric IO model at its core, calculating outputs and prices based on final demand and value added forecasts. Interindustry accounting enables the calculation of the tax base at a level of 71 industries. The model also includes equations for investment, profits, proprietor income and wages by industry, as well as cash flow and dividends.

We anticipate that the study results will be of interest to policy makers and to US and foreign companies that may be affected by the proposed tax reform. It should also be valuable to IO economists who are interested in developing IO-based models for analysis of tax policy. A preliminary version of this study, which treats the tax like a sales tax, can be found at http://www.inforum.umd.edu/papers/otherstudies/2017/blueprint_impact_analysis_011017.pdf.

Smile Curves in Global Value Chains: Creation and Distribution of Value-added and Job opportunities

Topic: (3.4) Special Session: Understanding the Most Recent Evolution of Global Value Chains: New Approaches Based on New Databases

Author: Bo MENG

Co-Authors: Shang-jin WEI, Ming Ye

The rise of global value chain (GVC) has brought dramatic changes to the world economy. However, given the increasing complexity and sophistication in cross-border production sharing activities, only using official trade data (e.g., gross exports or import) and GDP statistics has been unable to reveal the significance and nature of the quickly changing world economy. In order to show the evolution of GVC and how the GVC related economic phenomena impacts on the distribution of value-added and job opportunities across countries, we use the so-called “smile-curve” approach to show that countries and sectors can get very different value-added and job gains through different value-chain routes due to their position and degree of

participation in GVC. We further show that due to asymmetric information and control power over supply chains among various participants, joining GVC will increase economic efficiency, but may come with increased income inequality. How to resolve the distribution issue and help participants move up along “smile-curve” and their policy implications is also discussed in the paper.

Land Use Change and Electricity Models in a Multi-regional Hybrid Input Output Framework

Topic: (9.6) Environmental IO Modelling (6)

Author: Stefano MERCIAI

Co-Authors: Jannick Schmidt

This paper shows an extended version of the hybrid multiregional Input-Output table (MR-HIOT) derived from Exiobase v.3.

The multi-regional hybrid supply-use tables (MR-HSUTs), which are used to derive the input-output tables where tangible goods are accounted in metric tons, energy flows in TJ and services in euros. They respect mass, energy and monetary balances. The extensions include emissions, stock addition, stock reduction/depletion, supply and use of waste, supply and use of packaging, extraction of resources, use and withdrawal of water and land use.

The MR-HIOT here presented adopts a generalized version of by-product technology model (Stone’s method). Furthermore, a cause-effect based electricity model and indirect land use change (iLUC) model are inserted.

The generalized by-product technology model extends the Stone’s method to a a multi-regional framework and focuses on the respect of mass balance, whenever by-products substitute products with different properties produced elsewhere as principal productions.

The electricity model introduces the concept of national electricity grid where only non-constrained and competitive producers react to changes in demand. The electricity model was introduced by Schmidt et al (2011).

The iLUC model considers the substitution effects of the land use. The model was introduced by Schmidt et al. (2015). It simulates the effect of the substitution of land anytime a new production comes into place in any region of the world. Depending on the peculiarities of a country, the new demand of land may be obtained either by intensification the crops or occupying new land, i.e. forest or grassland. The emissions due to intensification and land use changes are taken into account.

The transaction matrix presented in this paper has a format 8213x8213; 164 products for 48 countries/world regions, 48 national electricity markets, six types of national land use markets for each of the 48 regions, and 5 world land use markets.

Schmidt J, Merciai S, Thrane M, Dalgaard R (2011). Inventory of country specific electricity in LCA – Consequential and attributional scenarios. Methodology report v2. 2.-0 LCA consultants, Aalborg, Denmark. <http://lca-net.com/p/212>

Schmidt J, Weidema B, Brandão M (2015). A framework for modelling indirect land use changes in life cycle assessment. *Journal of Cleaner Production* 99:230-238.

Country-specific Initiatives to Reduce Global Warming and other Environmental Impacts

Topic: (10.3) Input-output analysis for policy making (5)

Author: Stefano MERCIAI

The aim of the paper is to understand what are the main causes in the world economies of global warming and other selected impact assessments.

The paper determines the contribution to selected environmental impact of different human behaviors and needs. For such aim, the hybrid multi-regional input output table obtained in Exiobase v.3 is used.

Seven categories are taken into account. These are:

- Transportation
- Food consumption
- Heating
- Waste management
- Use of electricity
- Consumption of other good
- Demand of services

For each of the 48 countries/regions of the world included in EXIOBASE v3, the GHG emissions and other selected impact assessments are calculated relating to the above subdivision of the final uses. In this way it is possible to rank the most urgent measures to undertake in each country. Therefore, a map of hierarchical country-specific initiatives is obtained. Finally, it is determined the cumulative effect of a selection of country-specific initiatives on the world scale.

Does consistency with national accounts matter for calculating carbon footprints with global multi-regional input-output tables? A structural decomposition approach for comparing results for Belgium

Topic: (1.6) Environmental IO Modelling (1)

Author: Bernhard MICHEL

Co-Authors: Caroline Hambÿe, Bart HERTVELDT

This paper consists of a comparison of Belgium's consumption-based CO₂ emissions or carbon footprint over the years 1995-2007 calculated using three different underlying datasets:

1) National IO-tables: this implies making the assumption that the technology for producing imports, i.e. foreign technology, is identical to domestic technology (emissions embodied in trade approach).

2) Global multi-regional input-output tables from WIOD: these tables provide a much better estimate of the technology used for producing imports but data for Belgium do not fully respect the country's national accounts.

3) Re-estimated global multi-regional input-output tables from WIOD where data for Belgium are kept consistent with Belgian national accounts (WIOBEL, estimation along the lines of Eden et al., ESR 2015): this dataset combines the advantages of the two former, providing a more realistic picture of foreign technology while also respecting Belgian national accounts.

Our results show significant differences in footprints. The third dataset yields our preferred results for Belgium's carbon footprint. Based on global multi-regional input-output tables (WIOD and WIOBEL), Belgium's carbon footprint is significantly higher than its production-based emissions, while it is lower based on national IO-tables. The WIOBEL carbon footprint for

Belgium, i.e. the one based on the re-estimated global multiregional input-output tables that are consistent with the Belgian national accounts, is initially higher than the WIOD carbon footprint, i.e. the one calculated with the published data from WIOD. But its growth is slower so that from 2002 onwards the WIOD carbon footprint exceeds the WIODBEL carbon footprint. We then push things one step further and use structural decomposition analysis to determine factors that contribute to the difference with respect to the carbon footprint results obtained based on the latter two datasets. These factors comprise differences in emission data, differences in input-output data for Belgium (trade and domestic production structure) and differences in foreign technology.

Tracing value-added and double counting in sales of foreign affiliates and domestic-owned companies

Topic: (1.5) Global Value Chain and Vertical Specialization (1)

Author: Sebastien MIROUDOT

Co-Authors: Ming Ye

The literature on trade in value-added (Johnson and Noguera, 2012; Koopman et al., 2014) as well as empirical datasets, such as the TiVA indicators released by OECD and WTO in 2013, have emphasised that gross trade flows do not adequately measure the income generated by trade in a world characterised by global supply chains where intermediate products are traded across countries. New accounting frameworks have been developed to identify the domestic value-added in gross exports and in final demand and to remove the double counting of intermediate inputs that cross international borders more than once. But trade is only one dimension in the activities of firms involved in global production. Some of these firms are multinational enterprises (MNEs) that rely on foreign affiliates to source inputs or produce abroad. According to UNCTAD (2013), 80% of global trade is co-ordinated by these MNEs (when including their arm's length trade transactions as well as trade flows related to franchising, contract manufacturing and strategic alliances). The economic literature analysing activities of MNEs relies on the concept of sales of foreign affiliates, which is also a gross concept and includes some double counting with respect to foreign and domestic inputs. Somehow this concept has not yet been through the kind of 'TiVA revolution' that has significantly changed the analysis of trade.

In this paper, we first propose a new accounting framework for the decomposition of value-added into domestic, foreign and double counting terms in domestic sales. In this framework, we show where the value-added double counting terms are derived from and give an explicit expression of domestic and foreign double counting terms based on the Inter-Country Input-Output (ICIO) tables' Ghosh insight. This measurement can distinguish domestic sales from exports and can trace the value added and double counting in sales of foreign affiliates and domestic-owned enterprises. Then, we decompose GDP in the ICIO tables into four terms: (1) the domestic value-added which is exported and comes back, (2) the domestic value-added which does not participate in international trade, (3) the domestic value-added going through domestic transactions and ultimately absorbed in foreign countries and (4) the domestic value-added not going through domestic transactions and absorbed in foreign countries. The second term accounts for domestic sales while terms 1, 3 and 4 add up to a measure of domestic value-added in exports similar to Koopman, Wei and Wang (2014). There is still some overlap between value-added in exports and in domestic sales for two of these terms.

Based on this framework, we then calculate the value-added by foreign-owned and domestic-owned firms in exports and in domestic sales by using an Inter-Country Input-Output

table split according to ownership. A separate paper introduces this new ICIO (Cadestin et al., 2017). Preliminary results suggest that there is much more double counting in sales of foreign affiliates than in exports and that more value-added is created through exports than through sales of foreign affiliates. In 2011, we find that 69% of world GDP consists in value added by domestic-owned firms in domestic sales, 17% in value added by domestic-owned firms in exports, 9% in value-added by foreign-owned firms in domestic sales and 5% in value-added by foreign-owned firms in exports. These findings are consistent with theories suggesting that only the most productive firms engage in exports and among them an even smaller number in FDI, based on a higher productivity cut-off (Antràs and Helpman, 2004).

An ICIO split according to domestic and foreign ownership: the OECD TiVA-MNE project

Topic: (2.6) Input-output accounts and statistics (1)

Author: Sebastien MIROUDOT

Co-Authors: Charles Cadestin, Koen De Backer, Davide RIGO, Ming Ye

The development of Inter-Country Input-Output tables has been a big step forward to understand global value chains. The global Leontief inverse has allowed researchers and policymakers to measure trade in value-added terms and to identify the contribution of each country and industry to the value of final products. However, the picture is still incomplete. Global value chains are not only composed of independent companies exporting and importing intermediate and final products. Many of the firms involved in global value chains are multinational enterprises (MNEs) who have a network of foreign affiliates resulting from their foreign investment. As it is now, the main ICIOs, such as TiVA, WIOD or EORA, do not provide any information on the role played by foreign affiliates in GVCs. When 'domestic value' is added to exports, it can be the value added by domestic-owned firms but it can also be some value added by foreign-owned firms established in the country. The fact that foreign ownership is involved is not without implications. For example, in terms of income, it is likely that the activities of the foreign affiliates benefit the parent economy, either through direct transfers (e.g. repatriation of profit) or through spillover effects.

In this paper, we present ongoing work at the OECD aiming at adding an ownership dimension in the OECD ICIO and in the new WIOTs from the WIOD project (Timmer et al., 2016). The work first consists in the estimation of a full matrix of the output of foreign affiliates in 49 countries plus the 'rest of the world'. The starting point is the OECD AMNE database complemented with additional national sources when available. The data are made consistent with output as measured in the ICIOs and the missing information is estimated by various statistical ways. In addition to this matrix describing world output by country, industry and country of ownership, a trade matrix is created for the exports of domestic-owned and foreign-owned firms. Very limited information is available on such trade but what can be found in the AMNE database, the Trade by Enterprise Characteristics (TEC) database and some national sources is used, while a simple split based on the share of ownership applied to exports gives starting values to populate the whole matrix. Finally, as output needs to be split between intermediate consumption and value-added in the ICIO, a matrix of value-added ratios is also created for the domestic-owned and foreign-owned firms, using in some cases firm-level data.

Based on these three matrices (output, exports and value-added ratios by country, industry and ownership), both the TiVA and WIOD ICIOs have been split according to domestic and foreign ownership within each country and industry. In order to create transactions among domestic- and

foreign-owned firms, we use a methodology derived from the regional IO literature, CHARM (Kronenberg, 2009; Többen and Kronenberg, 2015). The results are preliminary and we are still working on improving the data and the methodology.

Adding an ownership dimension to ICIOs allows us to revisit TiVA statistics to show the contribution of foreign-owned firms to exports. In addition, we have developed a methodology to trace value-added and remove double counting in the sales of foreign affiliates (Miroudot and Ye, 2017), thus giving us the opportunity to compare the value-added in exports with the value-added in domestic sales for both foreign-owned and domestic-owned firms.

Unintended social consequences of EU financial framework 2014-2020

Topic: (5.2) Input-output analysis for policy making (2)

Author: Fabio MONSALVE

Co-Authors: Jorge E. Zafrilla, Maria Angeles Cadarso, Ángela García-Alaminos

Humankind is currently facing two major problems. First one is the moral imperative of provide the basics functionings (being happy, be able to choose, being healthy, nourished and sheltered...) to a growing population, in such a way that every human person had the effective possibility of enjoying the full human rights. Second, the pressing problem of climate change and its dooming future perspectives. The answer of the international community to target those problems has been the 2030 Agenda for Sustainable Development Goals (SDG) and the Paris Agreement for Climate Change. Notwithstanding, both action plans with its own objectives and paths, have arisen some concerns about two sides-targets alignments, trade-offs and opportunities.

Among the many participants committed with this international agenda, the European Union plays a substantial role given both its position as global player and its self-image as moral reference in issues related to human rights and environmental protection. Therefore, it could be more interesting to assess if the European Policies encapsulated in the 2014-2020 Multiannual Financial Framework are path-aligned or path-contingent with the previous two major agreements. Specifically, in this paper we will try to evaluate if the social impacts of the EU Funds are in line with the corollary of the 8th SDG, i.e, "promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all".

The methodological approach will be the combination of a fully integrated multiregional input-output (MRIO) model with a detailed estimation of 2014-2020 EU Multiannual Financial Framework which will allow us to research into the trade relations of target regions and, subsequently, to allocate the embodied social effects of EU policies. To address the "alignment-contingency-evaluation", we will rely on the calculation of several indicators for undesirable work conditions and forced labor and also in some of the social Satellite Socioeconomic Accounts provided by the World Input Output Database.

Mega Sports Events in Rio De Janeiro: An Analysis On The Impact On Employment

Topic: (7.2) Employment Analysis

Author: Everlam E. MONTIBELER

Providing quantitative information about the creation of jobs is a demand of society on the socioeconomic benefits of mega sports events. Thus, the inter-regional methodology of input-output, through its employment multipliers, is able to measure the number of jobs created, directly and indirectly, in Rio de Janeiro and the Rest of Brazil arising from expenditures in the periods of preparation and realization of the 2014 FIFA World Cup and of the Rio 2016 Olympic and Paralympic Games. The number of direct jobs generated as a result of investments for mega sports events was 49,970, with 38,521 new jobs created in the state of Rio de Janeiro and 11,449 new jobs created in the Rest of Brazil. Still, the generation of 414,744 new jobs, direct and indirect, generated in the economy of the state of Rio de Janeiro and of the Rest of Brazil can be credited to the preparation and realization of mega sports events. Therefore, we conclude that the mega sports events acted as catalysts in generating new jobs.

Spatially Explicit Footprints for Biodiversity, Carbon, and Air Pollution

Topic: (1.3) MRIO Modelling

Author: Daniel Moran

Co-Authors: Keiichiro Kanemoto

Environmental footprints can most easily be understood as maps of where a given demand bundle drives environmental pressure remotely. However currently most footprint-type results are developed and presented only numerically, not spatially. We present our approach for combining spatially-explicit (GIS) data on environmental impacts with a global MRIO to create spatially explicit footprints at the subnational level. This approach makes it possible to develop environmentally-extended MRIO models that resolve points of impact to below the national level e.g. to locations of biodiversity hotspots or points of pollution emission. This is possible because while economic activity data is, in most cases, available at a national or perhaps state level, observations of environmental impact associated with that activity are available at finer resolution. We present results for spatially explicit biodiversity, CO₂ and PM footprint hotspots. We present our three recent papers on these topics, include the paper on biodiversity footprint hotspots which was published in *Nature: Ecology & Evolution* and received wide press coverage including from *National Geographic*, *TIME*, *Scientific American*, and a number of other national magazines and newspapers. We discuss methodological details and steps forward. Maps of environmental footprints are intuitive to understand, useful for communication, and can be used to more precisely identify which states/regions/municipalities a consumer entity should engage which to reduce their induced environmental pressure.

An Approach for Estimating the Carbon Footprints of Cities

Topic: (8.6) Special Session: Consumption-based accounts for global cities: data, methods and analysis

Author: Daniel Moran

We develop a method for calculating the consumption-based carbon footprint of cities globally using the Eora MRIO.

[Note to Session Chair: this is an active research project and I have discussed with Anne Owen that I am not comfortable sharing much detail about it at this stage, since I am worried someone else may take the idea. The work will be submitted by June so it is fine to discuss at the conference, but I would prefer not to share much more detail before the conference to protect the idea.]

The role of technological change & labor productivity in the functional income distribution: a complexity approach to the cases of Brazil and Mexico.

Topic: (6.1) Special Session: Income distribution in IO models: Miyazawa revisited (1)

Author: Eduardo MORENO REYES

Co-Authors: Kaio Vital, Martín Carlos PUCHET ANYUL, Manuel García Álvarez

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, 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? "

The technological changes that take place when a sector moves from a sequential mode of supply, implies coordination and configuration of circuits of the sector with those of others. The indexes of sectoral circularity are the indicators that permit to measure this technological change and complexity of the net. Thus, by relating this indicator to labor productivity and the functional income distribution through tests of causality (Engle-Granger & Toda-Yamamoto), it is possible to answer the question asked.

The respective indicators are estimated 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. 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 complexity and, even less, research has been conducted to consider this indicator of a joint form with labor productivity to determine the functional income distribution.

The Water-Energy-Food Nexus of Bioenergy Consumption and Production in Brazil at State Level

Topic: (8.3) Environmental IO Modelling (5)

Author: Raul Munoz Castillo

Co-Authors: Kuishuang Feng, Joaquim J.M. GUILHOTO, Klaus HUBACEK, Laixiang Sun

Brazil plays a major role in the global biofuel economy as the world's second largest producer and consumer and the largest exporter of ethanol. On one hand, the biofuels sector in Brazil is interlinked with the main socio-economic system at the regional scale, and on the other hand, increasing demand for bioenergy products has been also largely driven by exports to other economies such as the USA, the EU or Japan, and demand is expected to increase in upcoming years.

However, biofuel crops require significant amounts of water and land resources that could otherwise be used for the production of food, urban water supply or energy generation. This is particularly important in Brazil where, despite the general believe of its comfortable situation with respect to water, there is an uneven spatial distribution of water resources among regions like the water-rich region in the North and West and the water-scarce South and Northeast. For example, the Sao Paulo Metropolitan Area (44 million people and 33% of national GDP) had undergone a severe water crisis in 2014, and other main Brazilian cities in the semi-arid Northeast region (i.e. Recife's metropolitan area) are suffering of increasing droughts that lead to competition for water resources among main economic sectors. Just these two regions alone account for 70% of the national ethanol production, which in 2007 was responsible for 60% of water irrigation use compared to 14% for other crops, nationally.

In this study we use an environmentally extended inter-state MRIO table for 2011 (149 sectors; 18 for agriculture, 3 for primary energy, 7 for power generation and 2 for biofuel production) combined with a global database for water footprint to assess the geographical distribution of green, blue and grey water and land footprints at the state level (27) associated with sugar cane-based ethanol production, responsible for 80% of bioenergy production in the country. The results from our study may better inform policy-making for proper water allocation among states and sectors with regard to biofuel production.

Determinants of country positioning in global value chains

Topic: (3.3) International Trade (1)

Author: Kirill MURADOV

Available evidence confirms that global value chains (GVCs) can be an important avenue for developing countries to build productive capacity and to integrate in the world economy at lower costs. But the gains from GVC participation are not automatic and require careful policy-making. According to the OECD, WTO and UNCTAD, "For policy makers, a starting point for the incorporation of GVCs in a development strategy is an understanding of where their countries and their industrial structures stand in relation to GVCs".

Naturally, countries differ in where they are located in the value chain. Position upstream in the value chain means that production requires mostly primary inputs, and outputs are supplied to intermediate users. This is typical for producers of raw materials or knowledge (e.g. research, design) that are required at the beginning of the production process. Position downstream means

that production requires more intermediate inputs, and outputs are supplied to final rather than intermediate users. Producers located downstream often specialise in assembling processed goods and providing customer services. The relative position in the GVC can change over time.

Positioning closer to the beginning of the production process is generally believed to secure higher value added shares and increase technological sophistication. Therefore, moving upstream or upgrading country position in GVCs are current policy priorities for many countries.

This paper refines a technique to identify country and industry positions in GVCs and explores how and why these positions evolve over time. Production, trade and consumption in the global economy are described in an inter-country input-output framework. Technically, the author isolates global value chain from domestic value chain and measures its length with respect to a country or an industry in two directions, forwards to the destination of outputs and backwards to the origin of inputs. Length corresponds to the average number of production stages a typical product has to undergo along this value chain. The key analytical indicator is a modified GVC position index that relates the average number of production stages that link output to final users to the average number of production stages that link the same output to primary producers through GVCs.

The paper goes further than Z.Wang, S.-j.Wei, X.Yu and K.Zhu who first proposed the GVC production line position index in 2016. First, the length components of the index are normalised with respect to total output. This means that total output serves as a common denominator ensuring that all lengths are entirely comparable. This also ensures that the GVC position index at the global level, i.e. after aggregation across all countries and industries, is exactly 1. Second, it is shown that GVCs are an equilibrium system where some countries can be positioned upstream only if other countries are positioned downstream. Country positions in GVCs are not independent from each other, and upgrading the position of one country will most likely cause downgrading the positions of some other countries. Third, a structural decomposition of the modified GVC position index is performed to isolate the impact of such factors as domestic input requirements, imported input requirements, structure of final demand and total value of final demand.

For an empirical application of the proposed analytical indicators, the paper utilises the 2015 edition of the OECD Inter-Country Input-Output (ICIO) tables. Calculations cover 61 countries plus rest of the world, 34 industries and the years 2000, 2005, 2008 and 2011.

Relative positions in GVCs appear rather stable for industries, but fluctuating for countries over time. Global changes in imported input requirements and total value of final demand are found to have the largest impact on country positions in GVCs. Meanwhile, the sector composition of output largely explains cross-country variation in GVC positions.

The results clearly illustrate that while some countries move upstream, other countries move downstream in GVCs. Although there is pronounced growth in overall complexity of cross-border value chains, it is unlikely that all countries simultaneously upgrade their positions as measured by the proposed index.

Analyzing Carbonaceous Aerosol Emissions in Asia using Endogenous Structural Path Analysis

Topic: (3.6) Environmental IO modeling (3)

Author: Fumiya NAGASHIMA

Asian countries use a large quantity of fossil fuels in the production of goods and services, generating harmful substances that are a major cause of air pollution. The fine particulate matter (PM_{2.5}) emitted by the production activities in China causes some serious environmental and health problems domestically and internationally through the transboundary air pollutants transport. Some previous studies have so far examined the driving forces of anthropogenic air pollutant emissions by sectors and regions, using environmentally extended input-output table (EEIOT) in the context of footprint exercises (Guan et al., 2014). As in Takahashi et al. (2014), however, residential emissions, usually treated as an exogenous sector, are much larger than industrial emissions in China, suggesting that household especially in rural areas is one of the largest emission sources of air pollutants in China. With this background, this study incorporates the household sector into intermediate input-output system as an endogenous sector using the China's inter-regional input-output database of 2007, and analyzes the environmentally-important paths with a focus of the residential PM_{2.5} emissions in 30 provinces of China originated from the flows of economic transactions, considering the provincial differences in income and consumption patterns and emission intensities. From the results, I found that the consumption activity in a major city of China, Beijing and Shanghai have contributed to significant air pollutants from residential sector in interior provinces through the income distribution in those provinces.

Analyzing Life-Cycle CO₂ Reduction Potentials of Motor Vehicle Inspection Policy

Topic: (10.4) Environmental IO modeling and CO₂ Emission

Author: Yuya NAKAMOTO

Co-Authors: Shigemi KAGAWA

In 2009, the Japanese government introduced a vehicle replacement scheme for replacing older cars with lower fuel efficiency by new cars with higher fuel efficiency to reduce CO₂ emissions from the transportation sector (Ministry of Economy, Trade and Industry, Japan, 2012). Although the demand policy such as the vehicle scrappage scheme has an effect of shortening "economic" lifetime of automobile rather than "physical lifetime" of automobile, there are only few studies about the life-cycle environmental impacts of changing the economic vehicle lifetime through the demand policy. This study develops an integrated assessment framework by combining dynamic discrete choice model (e.g., Rust, 1984) with the product lifetime analysis model (Kagawa et al., 2011). The parameters of the dynamic discrete choice model were estimated by using the annual car sales and replacement data during 1993 to 2014 (Japan Automobile Dealers Association, 2014) and annual average driving distance data during the same period (Ministry of Land, Infrastructure, Transport and Tourism, 2016). From the results, we addressed the following question of how the Japanese car inspection policy and scrappage scheme affected the life-cycle CO₂ emissions from vehicles through the entire economy. We found that modifying the regulation policy with a focus on car inspection system and a subsidy to support such maintenance cost for older cars that make car owners keep their automobile longer, would increase environmental benefits.

Hybrid LCA with MRIO for supply risk comparison among low-carbon energy technologies

Topic: (5.4) Industrial Ecology using IO Tables

Author: Keisuke NANSAI

Co-Authors: Sangwon SUH, Kenichi NAKAJIMA, Shigemi KAGAWA, Yasushi KONDO, Susumu Tohno

The Paris Agreement adopted during the 21st Session of the Conference of the Parties (COP21) has entered into force on 4th November 2016. It aims to reinforce the global efforts to attain “the 1.5 or 2 C target” which limits a temperature rise in this century to 1.5 to 2 C above pre-industrial levels. The ratified nations are required to make their best efforts for reducing own greenhouse gas (GHG) emissions through their Nationally Determined Contributions (NDCs). The pathway to the 1.5 or 2 C target is by no means simple, it is therefore inevitable to make a great change in the current system of production and consumption. NDCs of Japan include a 26% reduction of 2013 greenhouse gas emissions by the year 2030, which needs to promote development and expansion of low-carbon energy technologies in Japan. However, some of such technologies must use critical metals of which only few countries mine them, and some of these countries may not be economically or politically stable. Hence, there is a concern that Japan will be further exposed to supply risk of the critical metals with the reduction of GHG emission through the technological reliance. The study carries out hybrid life cycle assessment (LCA) for comparing the supply risk footprints among low-carbon energy technologies. The hybrid LCA combines process analysis and multiregional input-output analysis (MRIO) and calculates mining risk footprints of the technologies (photovoltaic solar, hydropower, wind power, electric vehicles etc.) with the assumption that they are introduced in Japan. The CEDA integrated scenarios is used to compile the process data on the technologies, and a global-link input-output model (GLIO) is employed as MRIO to ensure a global system boundary and high sector resolution of Japanese commodities. Mining risk is quantified by using the market concentration of output of the metals and political risk of the countries where the metals are mined. The mining risk footprint implies direct and indirect the mining risk affecting a technology through its consumption of the metal.

South Asian Free Trade Agreement (SAFTA) - Options for Pakistan

Topic: (2.4) CGE Modelling and Trade Agreements

Author: Olan Naz

Regional trade is a huge opportunity for economic growth in Pakistan and must be assigned priority in Pakistan's economic policy. South Asia remained one of the least integrated regions in the world. Intra-regional trade accounts for only 5% of South Asia's GDP, compared to 25% of East Asia's. Meanwhile, with a population of 1.6 billion, South Asia hosts one of the largest untapped talent pools. Economic Integration in South Asia is necessary for intensifying growth rates, trade volumes and improving living standards. While other regional organizations such as the European Union (EU), North American Free Trade Association (NAFTA) and Association of South East Asian Nations (ASEAN) have successfully attained this goal, the South Asian Association of Regional countries (SAARC) despite its establishment over a quarter century ago is nowhere near achieving this goal. Political strains and certain procedural difficulties block the full implementation of the South Asian Preferential Trade Agreement (SAPTA) and the South Asian Free Trade Agreement (SAFTA) which could have advanced economic integration in the region. South Asian countries have a great deal of economic potential and possess the will to exploit it through cooperation. This study analyses the performance of SAFTA countries and offers policy recommendations for facilitating economic integration by reducing non-tariff barriers as we see

that NTBs are by far the largest impediment to trade.

With this new backdrop, this study will use a global Computable General Equilibrium Model, well suited and tailor made for economy wide analysis. The latest available Global Trade Analysis Project (GTAP) Data base 9a and global GTAP model is used in this study. The Standard global GTAP Model assumes that all markets are perfectly competitive, all production and trade activities exhibit constant returns to scale, firms and household display profit and utility maximizing behavior respectively. Three alternate scenarios are designed to study the impact of reducing non-tariff barriers by complete removal of Trade-inhibiting affects; taxes, subsidies for Pakistan, India, Sri Lanka, Bangladesh and other South Asian countries under SAFTA agreement. The results show an overall huge positive impact on Pakistan's economy if the non-tariff barriers are removed by 14.7% as stated in the WTO report on 22 February, 2017. This will also raise real GDP in Pakistan, India, Sri Lanka and Bangladesh thereby offering a win-win solution for all.

The impact of current economic structure on the environment in Vietnam and China

Topic: (2.2) Environmental IO Modelling (2)

Author: Thao Phuong Nguyen

The impact of current economic structure on the environment in Vietnam and China.

In Vietnam, the strategy development is a priority for industrial and services sectors. Currently, the idea of economic restructuring is to promote the industrial sectors service sectors. So the rate of investment in these areas is increasing. However, the rate of value added in its output of these sectors is decreasing significantly. This means that the growth economy in Vietnam is ineffective. Moreover, the pollution fast is becoming an issue in booming Vietnam. Thus, Vietnam needs to review current economic structure, and then give some change of it. In addition, Vietnam and China have close relations both economics and politics due to the geographical location as well as the history of two countries. During the Vietnam development, the relationship between Vietnam and China is always the concern of policy makers. In general, the change of China economy has a certain impact on the Vietnam economy. Therefore, the economic comparison between Vietnam and China is necessary for policy decision-making in Vietnam.

The research question:

- The current economic structure of Vietnam? Compared with the economic structure of China.
- With the current economic structure, the effect of the Vietnam economy to energy and the environment? Compared with China economy.
- How Vietnam restructure the economy in order towards to improve the efficiency as well as environmental protection?

The method used:

The input-output model was developed by W. Leontief (1936, 1941). The input-output table is a tool to give a comprehensive picture of a country's economy. It reflects the inter-sectoral / inter-regional relationship in production as well as the use of products for final consumption, gross capital formation, exports of the whole economy. Furthermore, I/O table also show output required of a sector/region for a unit output of another sector/region and vice-versa. Therefore, Leontief model allows us to identify the spread of economics, import, energy, and environment by sector. Moreover, the model allows us to estimate the spread of final demand to the production, income, imports, energy and the environment. In addition, the Leontief model focus on the 'driving demand' (consumption) while the Ghosh model (1958) focus on the 'driving supply' (value added). Therefore, we can estimate the sensitivity of energy as well as emission per one unit increase in value added through Ghosh model.

The data used:

- The study based on data from the input-output table in 2012 by the General Statistics Office (GSO) that is the newest input-output table in Vietnam. This I/O table has distributed FISIM and exchange in USD.
- The input - output table of China in 2012 by National Bureau of Statistics of China (NBSC) that exchange in USD.
- CO2 emissions data is publicized by Input-Output World Database (WIOD) and the Ministry of Natural Resources and Environment Vietnam.

The novelty of the research:

In term of science:

This study will analysis economic structure based on the sectoral linkage structure. In addition, this study will estimate the impact of economics on the environment based on these structures.

In term of practical research:

This research will give a picture of the current economic structure of Vietnam and compared with China. Besides, the study will indicate the effect of economics on the environment of the Vietnam, compared with China. Therefore, this study will give recommendations for economic restructuring in Vietnam.

Effects of Economic Replacement Incentives for Consumers on Life-cycle CO2 Emissions

Topic: (1.7) Sustainable production and consumption

Author: Daisuke NISHIJIMA

Co-Authors: Shigemi KAGAWA, Masahiro Oguchi

In evaluating environmental burdens from consumer durables, product lifetime is a key factor and most of the previous studies used average lifetime or lifetime distribution with a focus of engineering durability (Müller 2006; Kagawa et al., 2011; Nishijima, 2016). These product lifetime modelling techniques did not consider consumer's behavior. Whereas, the product replacement modelling techniques based on the economic maximum utility theory have been developed in economics and marketing fields (Schiraldi, 2011; Melnikov, 2013). It is beneficial to apply the economic product replacement models to environmental research. This study attempts to integrate the product replacement model with environmental input-output analysis (Nansai et al., 2009; Shigetomi et al., 2015). As a case study, we focused on air conditioners and analyzed the impacts of economic incentives such as subsidies on the life-cycle CO2 emissions of the product in Japan. We firstly constructed the product replacement model following the proceeding studies (Rust, 1987; Gordon, 2009;). By reconciling the Bellman equation for discounted utility flow with the hazard function of products, we expressed the value functions of replacing old products with new products or keeping old products. We applied those value functions to the dynamic logit model and estimated the logit parameters by the maximum likelihood estimation. We used the annual sales and replacement data of air conditioners during 1993 to 2015 (The Japan Refrigeration and Air Conditioning Industry Association; The Japan Electrical Manufactures' Association) and maintenance cost data during the same period (Agency for Natural Resources and Energy of Japan). We integrated the dynamic replacement model into the final demand of environmental input-output framework. Finally, we estimated the life-cycle CO2 emissions of subsidies for replacing old air conditioners with new ones or for maintenance of older air conditioners and discussed how we can mitigate global warming through the economic policies of durable products.

Revisiting the Sequential Interindustry Model (SIM): Linkages and Inventory

Topic: (5.1) Special Session: Disaster Impact Analysis

Author: Yasuhide OKUYAMA

Economic analysis of unscheduled events or shocks, such as disasters and industrial accidents, has long faced a challenge to incorporate with the physical damage or disruption data of the event as the input data. Because of the differences in aggregation level, especially in terms of space and time, between the physical data and economic models, the sensitivity of the event, damages, or disruptions is often lost in the economic analysis. In order to make economic models more compatible with the physical data, a range of innovations in modeling scheme have been proposed, such as economic-engineering integrative models (see the examples in Okuyama and Chang, 2004). In this paper, the attention is directed toward the modification of economic model, namely the Sequential Interindustry Model (SIM) based on a conventional Input-Output Model, focusing particularly on the role of inventory in production process, as a risk management mechanism, under unscheduled events. The SIM model is also investigated through linkage analysis, which reveals temporal linkages among industrial sectors.

On the Sensitivity of Impact Estimates for Fixed Ratios Assumptions

Topic:

Author: Jan OOSTERHAVEN

Co-Authors: Johannes TÖBBEN

Firms react to shortages in the supply of their inputs by looking for substitutes. We investigate the impact of finding such substitutes on estimates of the size of the regional and national disaster impacts. To investigate this issue, we use the German multiregional supply-use table (MRSUT) for 2007, together with data on the direct impacts of the 2013 heavy floods of the German Elbe and the Danube rivers. We start with a non-linear programming model that allows for maximum substitution possibilities, and observe little to no indirect damages in the directly affected regions, whereas negative indirect impacts of a magnitude of 5%-7% and of up to 34% occur in other German regions and abroad, respectively. Adding the increasingly less plausible fixed ratios that are commonly used in standard Type I and extended Type II multiregional input-output and MRSUT models to our model, results in (1) substantial increases in the magnitude of negative indirect impacts and (2) a significant shift in the intra-regional versus interregional and international distribution of these impacts. Our conclusion is that input-output models tend to grossly overstate the indirect damages of negative supply shocks, which are part and parcel of most disasters.

Global City-level Household Demand: Data, Derivation and Deviation

Topic: (8.6) Special Session: Consumption-based accounts for global cities: data, methods and analysis

Author: Anne OWEN

Co-Authors: John Barrett, Guangwu CHEN, Thomas O. WIEDMANN

Global multiregional input-output databases (GMRIOD) provide a consistent framework that can be used to reassign greenhouse gas emissions from the producing to consuming nations. However, the final demand information contained within GMRIODs is typically at the national level. Subnational consumption-based accounts are usually based on single country's IO tables and it may not be advisable to make comparisons between cities in two different countries since the data sources and methods of constructing the country IO tables may be very different. In this paper we disaggregate national household final demand for countries in the GTAP GMRIOD to city and non-city expenditure. This allows for a consistent approach to calculating the environmental impact of the city. This paper reviews a variety of sources of city-level household consumption data. We present the many challenges involved in mapping data from both household surveys and data derived from geodemographic expenditure profiles to the sectors in the GTAP GMRIOD. Particular attention is paid to the multiple possible techniques for constructing weighted correspondence tables and the resulting changes this makes to the distribution of spends. We also present initial results and characterise, compare and contrast global cities in terms of the pattern of their expenditure and resulting impact. The paper concludes with recommendations as to the most suitable method for deriving household expenditure data and suggestions as to the potential applications for this type of research.

Factoring Inter-state Trade in Regional Input-Output Tables of States of India

Topic: (10.7) Regional input-output modeling (2)

Author: Bhanumati P

Co-Authors: Kakali MUKHOPADHYAY

India's internal trade amounts to less than 15 per cent of GDP, but still due to its population, India has one of the biggest markets within its own boundaries. However, there is a lack of reliable, comprehensive data on the quantity and value of products exported from a State to other Indian States or to other countries, and therefore, policy makers have found it difficult to clearly identify solutions or accurately evaluate the impact that policies are having on internal trade flows. The issue of lack of adequate data poses a problem in the compilation of Regional Input Output Tables, which could help in making policy suggestions for the States to build upon their comparative advantages.

In this paper, an attempt has been made to evolve a methodology to quantify the trade component for each state using two micro-level datasets - (1) the State Movement/Flows of Goods and (2) the Foreign Trade Statistics for India. Together, they detail good-specific trade flows bilaterally between Indian states and internationally between each Indian state and the world. On the export side, it includes the state of origin, the destination for cross-state trade, and the port of exit for international trade. For imports, it includes the state of origin in the case of cross-state trade and the port of entry for international trade. However, the interstate trade data, which is available in volumes and not in values, is 'priced' to make it suitable for use in the

Regional Input Output Table. The derived estimates are discussed for two major States of India, which have a strong production base of agriculture and manufacturing.

Vertical Specialization and Vertical De-specialization: New Long-run Evidence from Developing Countries

Topic: (8.8) Global Value Chain and Vertical Specialization (2)

Author: Stefan Pahl

Countries can nowadays export goods without producing all necessary intermediates. Firms in the respective country can import intermediates from abroad and specialize in a narrow range of activities, known as vertical specialization. However, the dynamics of vertical specialization are not well understood. On the one hand, vertical specialization is argued to follow a global pattern induced by ICT technology, while, on the other hand, it is argued to follow countries' stages of development. By means of a new, comprehensive data set of input-output tables for 100 countries since 1970, we can show that the latter finds no support in the data once we cover the whole data set. Instead, the evidence suggests a global time trend. Secondly, we characterize the dynamics of vertical specialization by identifying structural breaks in the time series. This novel approach yields large cross-country heterogeneity and shows that many countries initiate a process of vertical specialization, but only few sustain this trend. We show that vertical specialization follows periods of specialization and of de-specialization, which are therefore crucial for understanding the dynamics of vertical specialization.

Provincial CO2 Emission Transfers of China

Topic: (8.3) Environmental IO Modelling (5)

Author: Chen Pan

Co-Authors: Jianwu HE, Shantong LI

In the last decade, a large amount of emissions embodied in global trade have been tracked, which lead to concerns of emission transfers from developed countries to developing countries or 'carbon leakage' that will potentially undermine climate policies. Considering that Chinese sub-national regions have followed different pathways and are in different stages of development, in the early 2010s, several studies investigate the emission transfers between Chinese regions and found that there are significant emission transfers within China from its developing areas to developed areas. These findings have important implications for Chinese climate policies, suggesting that the emissions embodied in the sub-national regions should be considered when making regional policies. Recently, several changes have happened in China: CO2 intensity has decreased, production structure has improved, and the share of emissions from the production for domestic demand has increased. These changes, combined with the Chinese regional economic and climate-related policies, suggest a potential significant change in provincial emission transfers. This issue has important implications for climate policies, and has not been looked into. To investigate this, we build a Chinese multi-regional input-output table for 2012 at the provincial level, and calculate the CO2 emissions from fossil fuel consumption and cement production. The emission transfers between the provinces are then tracked, and the policy implications are discussed based on the findings.

TOWARDS AN INTEGRATION OF THE LEONTIEF AND SRAFFA SYSTEMS

Topic:

Author: Rajas Kamalakar Parchure

TOWARDS AN INTEGRATION OF THE LEONTIEF AND SRAFFA SYSTEMS

The production equations of the Sraffa system have an agrarian point input point output character. This paper presents a generalisation of the Sraffa system that is applicable to continuous input continuous output production processes. The resulting system turns out to be identical with Leontief's dynamic price model in the steady state. It is shown that all the important properties of the usual Sraffa system such as the impossibility of devising a physical measure for capital, possibility of reswitching to techniques, existence and uniqueness of the standard system, etc. are possessed by the Leontief dynamic price model as well. A further generalization has been made to include fixed capital to show how the problems of joint utilization, transferability of fixed capital between industries and changing efficiency of machines over their lifetimes can be tackled. Some empirical observations on the general relationship between the rate of profit, the on-cost markup rate and the rate of capital turnover have been presented. These form the basis for a new formulation of the dynamic price and output systems that can facilitate their empirical application. A notable feature of this formulation is that it automatically incorporates imperfectly competitive industries alongside the competitive ones.

Structural Change, Income Distribution and Growth: An application of China's DPN GEM

Topic: (4.5) CGE Modelling (2)

Author: Jiansuo PEI

Co-Authors: Cuihong YANG

When Xi Jinping took office in late 2012 as China's top leader, his administration inherited an economy ridden by excess production capacity, depressed consumer demand and unsustainable high growth rates, all due to long time credit expansion towards industries dominated by state-owned enterprises. The new administration has pledged to correct the distortions over his 10-year tenure to achieve sustainable and inclusive growth. Central to his reform agenda is to rebalance the economy and put the economy on a growth path driven more by consumer demand and innovation, and less by export and debt-financed investment. Market is to be given a bigger role to guide the restructuring process.

At the same time, the "Silk Road Economic Belt and the 21st-Century Maritime Silk Road," or the "One Belt and One Road" (OBOR) initiative, is being promoted in part to help destock the excess domestic production capacity. The initiative will also lead to increased exports as the production linkage is shaping up between China and the OBOR countries with Chinese firms as lead firms in the regional value chains, as observed in Yao et al (2014). The expected increase in normal exports to these countries mirror the slowdown of China's processing trade, as US outsourcing to China reaches its potentials (Constantinescu et al, 2014), FDI in assembly and processing sector seeks cheaper labor in other countries, and Chinese processing firms have learned to become producers of R&D intensive parts and components.

What would be the state of the Chinese economy in 2022 when Xi's two-term tenure ends?

For this set of complex policy initiatives, theory cannot predict the signs of their impacts, much less about the magnitudes. Econometrics methods are good at analyzing policies with rich historical data, but are less effective in dealing with structural changes. To quantitatively evaluate the income and growth impacts of China's structural reform under Xi, we need a China CGE model that can accommodate the policy shocks described above.

China's economy has a tripartite feature: two trade sectors (normal N and processing P trade) and one domestic production (D) sector. Conventional CGE models for Chinese trade policy analysis do not differentiate processing export and the rest of the Chinese economy, such as the standard GTAP model (Hertel and Tsigas, 1997). Economists have attempted to separate normal and processing trade in a CGE model for China (Ianchovichina, Martin and Fukase, 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 from the rest of Chinese economy and treats it as a separate economy in a GTAP-turned GVC model. The splits, however, are largely based on assumptions on key input-output coefficients and do not further differentiate export and domestic production sector.

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 DPN GEM. Following Pei, Yang and Yao (2015), we first update the 2012 data in our model to 2016 with real data: I, C G, normal and processing exports. Considering China is a large country, we reduce the substitution elasticity between imports and domestic products following the literature (Hillberry and Hummels, 2013). This produces a 2016 dataset that fits well with GDP, normal and processing imports. In so doing, we derive the unobservable variables: K-saving and Hicks-neutral technological progress, to reflect the country's FDI and innovation impacts respectively.

With the updated 2016 data, we do baseline projection from 2016 to 2022 with growth rates extrapolated from 2012-16 update exercise. Against this baseline, counterfactual simulations are conducted to reflect (i) adjustment of US outsourcing to China, and (ii) China's domestic structural reforms, and (iii) China's OBOR initiative. Various policy combinations will be experimented against this baseline scenario as they deviate from the normal growth path.

The Effects of an Openness to Trade for Brazilian Meat in NATURA

Topic: (2.4) CGE Modelling and Trade Agreements

Author: Fernando Salgueiro Perobelli

Co-Authors: Ramon Goulart Cunha, Vinicius A. VALE, Lucas Mendonça Vargas

Based on the "National Plan for Exports 2015-2018" (PNE 2015-2018), we can highlight the following countries in terms of high potential market to the Brazilian meat in natura: Angola, Saudi Arabia, Algeria, Chile, China, Colombia, Cuba, Egypt, Germany, Iran, Japan, Paraguay, Russia, South Korea, United Arab Emirates, United Kingdom, United States of America, Uruguay and Venezuela.

There are some recent stylized facts that enable us to better understand the movement or perspectives of this external market. The United States is the largest producer and consumer of meat in natura while Brazil is the second largest producer in the world and the largest exporter. In the first half of this 2016, Brazilian foreign sales reached US\$ 2.22 billion (or 571.5 thousands of tons), highlighting the sales to Hong Kong (US\$ 393 million), China (US\$ 365 million), Egypt (US\$ 329 million), Russia (US\$ 181 million) and Iran (US\$ 168 million).

On the other side, the 2016 Brazilian exports, in volume and in revenue, of meat in natura and processed beef fell in comparison with the previous year. According to data from the Ministry of

Industry, Commerce and Services (MDIC), 1.350 million tons were exported, 1% less than 2015 (1.361 million tons). In terms of revenue, the decline was 8%, from US\$ 5.795 billion to US\$ 5.340 billion. Further, if we look to 2014, we can that year was even better; the exports were 1.575 million tons and revenues were US\$7.149 billion.

However, the perspectives are optimistic since there are some potential new markets, a more favorable exchange rate, the increase Chinese demand and the opening of the American market for the Brazilian meat in natura. Brazil and United States signed the Letters of Equivalence Recognition of Beef Control, which can lead to an openness of the American market to Brazilian meat and consequently increase the share of the Brazilian economy in other markets and in the international products of agricultural products.

It important to highlight that the bilateral agreement between Brazil and United States is based on import quotas. According to the Bureau of International Agribusiness Relations (SRI) from Agriculture Ministry, Brazil now has the same quota than Central American countries, 64,800 tons per year with a rate of 4% or 10% depending on the cut of the meat. Outside the quota (with no quantity limit), the tariff is 26.4%.

Given this context, this study aims to evaluate the effects of an openness trade for the Brazilian meat in natura, such as an agreement between Brazil and United States, and its systemic effects on the Brazilian economy, which is in in line with the PNE 2015-2018. In order to reach this aim, we explore two comparative scenarios. The first one based on the analysis of the impacts upon the Brazilian economy of the agreement between Brazil and USA; the second based on the idea to measure the impacts of the market opportunities listed in the PNE 2015-2018 for the meat in natura, considering two situations: a) Brazil reached completely the objectives listed at PNE; b) Brazil reached part of the objectives listed at PNE. For this purpose, we used the database and model from Global Trade Analysis Project (GTAP) - version 9, calibrated to the year 2011.

Spillover Effects of Germany's Final Demand on Southern Europe

Topic: (8.4) International Trade (3)

Author: Oliver Picek

Co-author: Enno Schröder

(1) Research question and Abstract:

We calibrate a closed multi-country input-output model with data from the World Input-Output Database to predict spillover effects of Germany's final demand on GDP, employment, and the trade balance in Southern European countries. The spillover effects are generally found to be small because the increase in imports is shared between many countries. They are comparatively larger for adjacent countries as well as Eastern European countries included in the German production network. Therefore, Germany alone is unable

to make a significant contribution to the external adjustment process in the European South. A common expansion of the surplus countries within the European Union yields a limited magnitude of spillovers as well. However, a Northern European expansion does cause an improvement in the trade balances of the Southern European countries. If the latter decide to expand their economies as a result (in a smaller, and thus asymmetric fashion), strong own multipliers of the fairly closed Southern European economies can cause a sizeable domestic expansion. Overall, successful policies to help growth and employment in Southern Europe must spend funds domestically (either transferred from Germany or raised by domestic governments or the European Union) instead of relying on spillover effects.

2) Method: Impact Analysis based on Multi-regional Input Output Tables

3) Data: World Input-Output Database +

(4) Novelty: Similar estimates based on simple open models for value added or the trade balance already exist and yield very small spillover effects. These models, however, omit Keynesian consumption multipliers as well as any effect of increased profits on investment, and therefore might underestimate spillover effects. In this comprehensive study, we thoroughly include the value added, employment and trade balance effects and compare them across three models. By closing the model with respect to households and firms we do find higher spillover effects more than double the size of the open model, but do have to confirm their limited magnitude even given the more optimistic assumptions on economic multipliers. We are also able to simulate scenarios of asymmetric expansions, providing a potential counterfactual history of Eurozone current account rebalancing.

Comparison of Mathematical Methods for SUT Construction Using WIOD Database

Topic: (10.5) Methodological Aspects of IO Analysis (4)

Author: Dmitri Piontkovski

Co-Authors: Sergey Kuznetsov, Denis Sokolov, Olga Starchikova

We investigate the relative effectiveness of the projection methods of Supply and Use tables in relation to Use tables. The empirical bases of the study are the Use tables of 28 countries for the period from 1995 to 2010 from WIOD project. We conduct a comparative study of three mathematical methods that have proven the most effective in constructing projection of Use tables for Spain and the Netherlands from the empirical study by Temurshoev, Webb, and Yamano (2011). In these methods, Input-Output, Supply, and Use tables are constructed based on the benchmark table and the sums of the columns and the rows of the table under construction. Whereas the results of Op. Cit. show that the GRAS method is the most effective for the IOTs and for the Supply tables for Netherlands and Spain, in the case of Use tables some quadratic methods show similar results as GRAS.

Essentially, our results confirm the conclusions of Op. Cit. The most effective of the considered methods is GRAS, a version of the classical RAS algorithm. The results of applying this method under the number of criteria are closer to the published tables than the results of the INSD method and Kuroda method, which are based on quadratic programming. At the same time we have shown that in some cases the table cannot be balanced by GRAS method because of significant changes in the structure of the table. In 80% of these cases the tables were successfully balanced by the two quadratic methods. In these cases the Kuroda method is the most effective.

Our work is motivated by a recent project of retrospective construction of SUT for Russia. We conclude that GRAS method is a priority in the extrapolation of Use tables of Russia. At the same time, if the structure of the table under construction is expected to be essentially different from the structure of the benchmark one then a version of Kuroda method is more appropriate.

Border Carbon Adjustment: An empirical investigation into the politics of climate change

Topic: (3.5) Designing of Energy Policies with I-O

Author: Radhika PIPLANI

Significant recent attention has been drawn by the United States Waxman Markey Bill of 2009. It proposes an attempt to tackle the competitiveness and carbon leakage concerns of the nation's energy intensive industries by prompting at a measure like Border Carbon Adjustment. Using the Input-Output approach this study tries to assess the impact of a border carbon tax applied by the United States on India's export sector and the change that takes place in the value of production. Further, it finds out the impact on the resulting carbon emissions in India after a border carbon tax is imposed. The study empirically estimates whether the domestic emission reduction of the United States is partially or wholly counterbalanced by increased emissions in India. The results predict that carbon leakage takes place from U.S. to India due to difference in the technology of production. Imposition of a border tax of \$10 and \$25 per ton of carbon emission embodied in the exports leads to significant fall in the export of basic and heavy industries from India which have high carbon emission intensity per unit of output. India also witnesses a fall in the value of production as a result of fall in the exports. The resultant fall in the carbon emissions embodied in the exports is positive but modest. With the recently elected government in the United States, the imposition of a border tax does not look like a distant reality. This study stimulates the impact of a border tax if imposed on the carbon content of the goods imported in U.S.

Key Words: carbon leakage, energy intensive industries, border carbon adjustment, input-output, carbon emissions

Productivity in the Brazilian Industrial and Service Sectors, 2000-2009: A Shift- share Analysis

Topic: (3.1) Methodological Aspects of IO Analysis (1)

Author: Luiza Nassif Pires

This paper conducts a study of the evolution of some indicators in the Brazilian economy between 2000 and 2009 derived from Input Output tables. Historically, changes in production structures essential to development are associated with industrial sectors, or at least the source of the changes they cause in sustained output growth appears to arise in the growth of industry participation in the product.

The present debate in the literature on industrialization questions what is unique about the industry. Kaldor's Three Laws (1978) present one way to frame the peculiarities of the industrial sector: (i) the existence of a positive relationship between the growth of labor productivity in the economy and the growth of industrial output (Kaldor-Verdoorn) (ii) the positive relationship between the growth rate of industrial output and the growth rate of total output, and (iii) positive relationship between the growth rate of total output and the rate of productivity growth in the other sectors of the economy .

These laws, formulated from empirical analysis, point to productivity gains inherent in industrial activity. These productivity gains are related to the existence of economies of scale, static and dynamic, conceived as a macro phenomenon, as formulated by Kaldor (1978) and Young (1928).

According to these authors, such savings can not be broken down properly observing variations in the size of individual firms or industries, can arise because of externalities and spillovers from other sectors. If economies of scale have ceased in a given sector, this can benefit the expansion of production in other sectors of the economy.

From this perspective, economic growth is seen as a process in which productivity gains and output growth feedback into one another. Such a mechanism would be unique in the industry, particularly in the manufacturing industry. Going further, we can say that such a mechanism is developed more intensively in this sector because that is where we have a more dynamic structure of generation and diffusion of innovations.

The pioneers of development economics, namely Rosenstein-Rodan, Hirschman, Lewis, Singer, and Nurkse, were concerned with finding the conditions that would enable developing nations to achieve the economic and social stability of developed nations. They argued that the process of industrialization brought about structural changes to the economy that lead to development. These authors emphasized three characteristics of the industrial sector: 1) the existence of external economies that would carry over into other sectors of the economy 2) the capacity to link growth to the rest of the economy, and 3) the high productivity of industrial activities.

This work begins by analyzing the theoretical literature of these pioneers of development economics, which emphasize the role of productivity gains in the industrial sector for economic

development. It then moves into an empirical study of the Brazilian economy between the years 2000 and 2009 through various productivity indicators derived from Brazilian Input-output tables, among which is a shift-share analysis to define key sectors in terms of their contributions to productivity growth within the Brazilian economy. The Brazilian Institute for Geography and Statistics (IBGE) provides the tables according to two aggregations. In one, the aggregation consists of 12 sectors. The other aggregation has 55 sectors and 110 products, using the NACE 1.0. For this paper, the matrices from 2001 to 2004 and from 2006 to 2009 were estimated at 55 sectors using the RAS method. Both the 55 sectors classification and an aggregation composed of 19 activities were used.

The paper concludes that although a concern with the development because of an alleged deindustrialization is a careless analysis of available indicators, in fact there should be a concern to Brazilian industry since the late twentieth century. However, this loss of quality cannot be associated with loss of participation. This is not a dynamic loss in the industry due to the reduction of its range. The industry grows over the period at a similar rate as the GDP. Loss of productivity of industries must be explained by factors internal to the industry.

The law of evolution in time and space and the application of demand pull model of urban resident's consumption structure in China

Topic: (3.1) Methodological Aspects of IO Analysis (1)

Author: siru ren

Co-Authors: Xu Jian, Haoyang Zhao

Abstract: As China's economy steps into the era of the new normal, consumption becomes a new growth point and motive force for the economy. Urban residents are important consumption

subjects; thus evolution of their consumption structure of urban residents plays a key role in the adjustment of industrial structure. Classic demand pull model of input and output only considers changes of total consumption at large in the study of impacts of final consumption. However, it is obvious that the treatment of assuming the consistence of consumption structure with that of recent investigation years in readjustment period of economic structure will lead to severe simulation bias. This paper deeply analyzes the basic characteristics of the spatial and temporal variation of key consumption coefficients of urban residents. Furthermore, this paper selects several influence factors to conduct panel regression of the key consumption coefficients in accordance with consumption theories, obtaining some factors with significant explanatory power. This paper simulates the pulling effects of consumption of urban residents in 2015, based on constructed models. Firstly, regression model is adopted to get predictive values of the key coefficients. Then, the consumption structure of urban residents in 2015 is modified according the above-mentioned. Finally, this paper applies demand pull model to the modified consumption structure as a way of calculating the pulling effects of the consumption of urban residents on various industries. Compared with the measured value of total output which still uses the traditional consumption structure of 2012, the result indicates significant differences. The application of wrong assumptions in consumption structure will markedly underestimate the pulling effect on the total output.

Keyword: consumption structure, key consumption coefficients, analysis of input-output, demand pull model;

The new EXIOLab - compiling and updating EXIOBASE V.2 in a virtual laboratory

Topic: (8.7) Special Session: The Current State & Future plans of Global MRIO databases (1)

Author: Rachel C. REYES

Co-Authors: Arne GESCHKE, Arjan de Koning, Richard WOOD, Tatyana Bulavskaya, Konstantin STADLER, Hagen Schulte in den Baeumen, Arnold Tukker

In this work, we explore options to reconstruct the second version of EXIOBASE multi-region input-output (EXIOBASE2 MRIO) database in the EXIOLab collaborative cloud-computing laboratory environment. Whereas EXIOBASE2 uses a multi-process reconciliation procedure with the major steps of (1) detailing and harmonising country tables into high-resolution common classification and (2) linking of these tables via trade, in this paper, we focus on combining these steps and using alternative mathematical reconciliation techniques with the virtual laboratory's high-performance computing capability. We use both EXIOBASE2's pre-processed data and final tables in defining an optimisation problem that confronts the compiled MRIO table with conflicting data sources, tagged with user-defined standard deviation estimates, giving the researcher some degree of influence over the adherence of the compiled table to its sources. Visualisation tools, distance measures and detailed diagnostic tests are made available in the lab for increased transparency on reliability and uncertainty information, useful for interpreting MRIO-based studies. For illustration, global carbon, water, land and materials footprints are calculated with EXIOLab and are shown to vary slightly from previously reported resource footprints. The simplification and flexibility offered by the new EXIOLab present opportunities in IO-based research to be more timely, topical and relevant especially for swaying environmental and socio-economic policy decisions towards promotion of wellbeing and sustainability.

Understanding the energy metabolism of World economies through the joint use of Production- and Consumption-based energy accountings

Topic: (1.1) Energy Input-Output Modeling (1)

Author: Matteo Vincenzo Rocco

Co-Authors: Rafael Joaquín Forcada

Understanding, quantifying and representing the global primary energy supplied and demanded by sectors of national economies is nowadays crucial for policymakers in order to define effective policies and to properly set energy efficiency and saving targets.

Energy accountings based on the traditional Production-based paradigm allows to understand how primary energy is directly extracted, traded, transformed and used within each economy. On the other hand, Consumption-based energy accountings allows to understand the ultimate economic purposes of such energy flows. Therefore, the information provided by the joint application of these approaches may provide useful and complementary insight on the global energy economics, allowing to identify hotspots for potential interventions from both the supply and demand side.

This paper analyzes and represents the energy metabolism of the World economy based on a Multi-Regional Input-Output framework, taking into account non-renewable fossil energy, namely raw coal, crude oil and natural gas. The research is based on IEA energy data and on the EORA26 database, considering year 2013.

Starting from the results of a conventional Production-based analysis (IEA data), a method is here proposed to decompose the energy embodied in final goods and services: from the supply side, it allows to quantify the energy directly and indirectly invoked by the sectors of all the economies to produce the final demand of the others. Conversely, from the demand side, traditional Leontief impact model allows to account for the energy embodied in products consumed as final demand by each economy. The results of both the analyses are finally reconciled in order to provide one unique Sankey diagram.

The main novelties of the paper resides in (1) the definition of a unique Sankey diagram through the joint use of Production- and Consumption-based approaches, and (2) the differentiation between embodied energy supply and demand in Energy Input-Output analysis.

The Current State of Regional Economic Impact and Policy Modeling in the U.S. and Beyond

Topic: (5.6) Special Session: Shifting Scales of Macro-econometric Modelling to State-Level Economic, Energy and Environmental Policy Analysis for India(E3-India)

Author: Nicolas Rockler

Within the realm of applied regional economic analysis, practitioners have seen drastic changes over the last fifty years in types of models they use to provide guidance on economic development and public policy issues. We have gone from the use of simple economic-base and shift-share modeling to aid in the estimation of benefits and costs to the regular application of so-called "hybrid" regional policy analysis models that offer the highly detailed sectoral analysis based on input-output models that are linked to partial-equilibrium timeseries econometric models. As the tools have improved, the depth and breadth of analysis has grown sizeably. We will discuss is whether our improved tools have really taken us beyond the benefit-cost analysis and the ratios that were once the determinants of policy choice to evaluate complex development projects or investments that significantly alter markets and improve the lot their

participants.

In this paper, we will:

1. Review the application of Post WWII regional models, beginning with benefit-cost models of evaluating potential public actions and ending with the newest policy and forecasting models that combine input-output modeling and econometric timeseries analysis.
2. Examine the nature of the analysis performed with each of the broad model-types. What is measured, for where is it measures, what is estimated, and most importantly, what is assumed away?
3. Discuss what is missing in our current approach and identify the concepts that are both critical and still missing in our models today.

Distributional Effects of the EU Climate and Energy Package in Poland

Topic: (1.1) Energy Input-Output Modeling (1)

Author: Bartłomiej Rokicki

Co-Authors: Kenia B. DE SOUZA, Luiz Carlos de Santana Ribeiro

The European Union Emissions Trading System (EU ETS) is a 'cap and trade' system introduced in 2005 in order to meet emissions reductions required by The Kyoto Protocol. It caps the total volume

of GHG emissions from installations and aircraft operators and allows trading of emission allowances. With the 8% share in total EU27 GHG emissions, Poland plays an important role in the achievement of the EU climate and energy policy objectives. The main energy source in Poland is obtained from the coal-fired power plants which contribute to increase the GHG concentration in atmosphere. This paper aims to measure the impact of the EU 2020 carbon taxation package on the Polish economy. We take into consideration different tax levels and the effects over welfare and

income for ten different household groups based on 2010 data. The following databases are used: Poland Input-Output Matrix, Household Budget Survey, National Household Sample Survey and emissions data from the National Centre for Emissions Management (KOBiZE). A Leontief price model is developed, taking into account the Polish input-output matrix weighted by the intensity of

GHG emission of each industry. Considering alternative scenarios, where the tax ranges between 16.275 to 30 euro/ton of GHG emissions, main results show a significant emissions reduction (between 4.97 and 8.53%), and a small negative impact on output (from -0.86 to 1.53%), considering taxation over European Union's Emissions Trading System' selected sectors. Electricity, gas, steam

and air conditioning is the most affected sector, followed in a much lower scale by Waste collection, Sewerage; remediation services; Agriculture and Non-metallic mineral products. Furthermore, the

income and welfare losses are lower in the four richest household groups.

The Impact of the Development of Unconventional Gas and Oil in Argentina: A Multi-Regional Input-Output Model

Topic: (9.3) Energy Input-Output Modeling (3)

Author: Carlos Adrian Romero

Co-Authors: Leonardo Javier MASTRONARDI, Juan Pablo Vila Martínez

According to the US Energy Information Agency, Argentina has the second shale gas reserves and the fourth shale oil reserves in the world. Also, Argentina is now one of only four countries (along with the US, Canada and China) to produce commercial volumes of crude oil from tight formations. The reservoirs are concentrated principally in the Vaca Muerta field ("Dead Cow") in the province of Neuquén. The government has encouraged investments to develop a large-scale production. The required amount of investment until 2025 is estimated between 35 and 50 billions of Dollars.

While stressing the importance of the sale oil and gas (O&G) discoveries, there is a lack of studies evaluating its impact on the economy. The objective of the paper is to assess the effect of the exploitation of Vaca Muerta on the region and the whole country.

A hybrid bi-regional SAM was built to analyze the impact of Vaca Muerta in Neuquén province and in the rest of Argentina. For the construction of the RSAM, we use a national SAM using: i) an existing input-output matrix for Neuquén, ii) state data from production and exports, iii) specific information about O&G production, iv) non-survey estimations of IRIO with additional information which was included to improve the precision of the models.

With the RSAM, we simulate the impact of an increase in production of shale O&G resources in the province with alternative regional input-output and SAM models. The results allow observing the effect on the different activities (in and out of the region). This will help to identify potential bottlenecks that it should be removed to reach the production goals.

Multiregional Input-Output Analysis of NAFTA

Topic: (1.3) MRIO Modelling

Author: Pablo RUIZ NAPOLES

Co-Authors: Normand Asuad Sanen, Martín Carlos PUCHET ANYUL, Eduardo MORENO REYES

Multi Regional Input-Output (MRIO) analysis has produced some multiregional input-output matrices regarding relatively integrated areas like the European Union or some sub-regions within it. In this case, using the same methodology we'll be analyzing the North American Free Trade Agreement (NAFTA) based on one of the two trilateral matrices, one produced by the World Input-Output Database (WIOD) and the other by the Mexican National Institute for Statistics and Geography (INEGI), each with a different aggregative level.

NAFTA entered into operation in 1994 and, so far there has not been a Regional Input-Output analysis with respect to its results for its three signing parties, Mexico, the US, and Canada. When signing the agreement in 1992, the expected results were announced as the expansion of trade, output and jobs for the three countries, that is a so called, win-win agreement.

This treaty has become worldwide popular since recently elected president Donald Trump proposed in his campaign to modify the treaty for the benefit of the US, claiming that his country

was losing jobs due to NAFTA.

Our purpose in this work is to analyze what has happened on these three variables, trade, output and jobs in the three signing countries in these 23 years of NAFTA operation, specifically due to the agreement. It is also the objective of the study to differentiate what sectors in each country have benefited more in each country and in what sense, since we know that the benefits have not been distributed equally in either country. That might help us to evaluate the efficiency of this treaty based on hard data as a trade policy for each of the participants. In addition, there is the possibility of analyzing the impacts of NAFTA on the border states of Mexico and the US.

Structural Analysis of the Top Five Most GHG Emitting Economies

Topic: (6.2) Environmental IO modelling (4)

Author: Pablo RUIZ NAPOLES

Co-Authors: CASTAÑEDA LEÓN JAVIER, Eduardo MORENO REYES

In this paper, we analyze the economies of the five most GHG emitting countries in 2011, according to the data from the World Bank. These countries signed the Paris Agreement on Climate Change in December of 2015, and participated in the Conference of the Parties, of the United Nations Framework Convention for Climate Change in which they established their goals for GHG emissions reduction, called Intended National Determined Contributions.

The purpose of studying these five countries has been concentrated on analyzing the trends their GHG emissions will follow from 2011 to 2030. In order to accomplish this objective, we have used some techniques derived from Input-Output Analysis and the I-O data from the World Input-Output Database. These allowed us to determine which sectors of the five economies can be considered key sectors. Also, we could establish which sectors were the higher GHG emitting ones in each of the economies under study.

We also built an Environmental Input-Output model, with the purpose of forecasting GHG emissions of each of the five economies, under two alternative scenarios. One of the scenarios was the so-called "Business as usual", which means doing nothing to reduce GHG emissions. The other scenario utilized a different Input-Output Matrix one which was modified to incorporate a technological change in four selected sectors. That is, we simulate a technical change in the selected five economies.

The results were that three countries, the USA, Russia and Japan established clear and feasible goals for 2030 and their targets trends suggest they will be applying mitigation policies that consist in technological changes in sectors that are key or high emitting sectors, or both, like the ones we chose for the study. China's committed goals for 2030 are very low as compared to the other four countries, relatively speaking. Our simulated forecasting of GHG emissions reduction through technical change is above the level they are committed to reach. India, is not committed to reduce the absolute GHG emissions level, so in order to actually reduce this level of emissions for 2030, it becomes clear that they should apply a technological change.

Studying the structures of income distribution and production with Social Accounting and Input-Output Matrices

Topic: (2.6) Input-output accounts and statistics (1)

Author: Susana Santos

Social Accounting and Input-Output Matrices will be presented as tools for the study of the socio-economic activity of a country, paying especial attention to the structures of income distribution and production.

Activities (or industries), products, factors of production and institutions will be worked together in matrices, from which networks of linkages will be identified and the structures of income distribution and production will also be studied. Our main objective is to research the influences of these structure on the socio-economic activity of a country.

The National Accounts will be adopted as the base source of information for the construction of numerical versions of these matrices, being described the corresponding methodologies and nomenclatures, considering the latest version of the System of National Accounts (2008 SNA). A basic version of the two matrices will be presented first, with focus on the need to ensure consistency with the whole system. Such a need will then be reinforced through the analysis of possible disaggregations and extensions to these basic versions.

Macroeconomic aggregates, indicators, and balancing items that can be calculated from these matrices will also be presented.

Portugal will be our case study.

Can a combination of efficiency initiatives give us “good” rebound effects?

Topic: (6.3) Energy Input-Output Modeling (2)

Author: Cristina Sarasa

The increasing depletion of natural resources as well as pressures on the environment and natural resources has highlighted the need of a more efficient use of energy and a development process of alternative energy sources over the last years. Energy-saving and energy-efficiency improvement implies monetary and emissions savings. These savings are off-set by additional expenses in other sectors, called rebound effects. In a world of high pressures on the environment, more efficient uses of energy are required to be increased at all stages of the energy chain from generation to final consumption.

Taking Spain as a case study, we use the first energy-related CGE model that develops the inclusion of renewable energies and is calibrated on the 2010 input-output data. This paper evaluates the best combination of efficiency initiatives aimed at achieving a positive result through increased energy efficiency in household consumption and the production of more competitive electricity from renewable sources. Our central aim is to test which is the best combination of efficiency initiatives both production and consumption side to achieve positive rebound effects.

Our findings show that a package of improvements in electricity and petroleum household use and more competitive renewable energies achieve reductions in all energy uses with the related positive results in the economy. This strategy reaches the penetration targeted of renewable energies in the total energy use combined with reductions of non-renewable energies. This is the only one way to boost renewable energies use in the economy, reducing energy use of non-renewable sources and drives the economy forward in a sustainable path.

GHG emissions-reduction targets applied to Spain: A dynamic approach for the climate change road to Paris agreement

Topic: (3.5) Designing of Energy Policies with I-O

Author: Cristina Sarasa

Co-Authors: Rosa DUARTE, Julio Sánchez Chóliz

Recent warnings about the impacts of climate change have led international climate negotiations to focus on the necessary global long-term goal (LTG) presented in the Paris agreement (COP21). Over 120 countries, numerous non-governmental organizations, and many corporate leaders support LTG propositions on the basis of voluntary cooperation and widely disseminated information on national contributions, to achieve sustainable development with zero emissions by 2100, compatible with the achievement of poverty eradication and equity (see IPCC (2014) and FCCC (2015)). However, the starting point for each country and agency differ considerably, and specifically- defined national objectives are demanded necessary.

Based on a Computable General Equilibrium (CGE) model, calibrated with Spanish data for 2010 and including GHG emissions and energy demands, this article considers the Paris Accords by defining and comparing a range of dynamic 2010-2100 scenarios in which the Spanish economy advances to zero emissions. We also evaluate the long-term economic and environmental impacts to 2020, 2030, 2050 and 2100. Specifically, our simulated scenarios are based on criteria from the Paris agreement and the EU climate strategies and targets, considering Spain. These scenarios define, on the one hand, improvements in the use of energy produced by the current technologies, in other words, the reduction of the unit direct coefficient of emissions from productive activities and from households. On the other hand, we also evaluate the impacts of technological improvements in the use of energy, both in production and households, implying a better use of technology.

Our findings suggest that significant emissions reductions could be achieved, compared to the expected evolution if nothing is done, reductions which are undoubtedly very important to progress in the battle against climate change.

Two paths to emission reductions: Energy efficiency and Renewables

Topic: (5.6) Special Session: Shifting Scales of Macro-econometric Modelling to State-Level Economic, Energy and Environmental Policy Analysis for India(E3-India)

Author: Saket Sarraf

Co-Authors: maithili iyer

Organized Sessions

Session Organiser: Kakali Mukhopadhyay, Department of Agricultural Economics McGill University, and Gokhale Institute of Politics and Economics, Pune, India

Session Chair: Kakali Mukhopadhyay, Department of Agricultural Economics McGill University, and Gokhale Institute of Politics and Economics, Pune, India

Abstract

As India moves towards meeting its Intended Nationally Determined Contributions (INDCs) to emissions, policy makers have to choose among alternative policy options. The investment in renewable energy continues to be the primary choice. Energy efficiency is relegated to the

second place as savings are not visible and its economy wide impacts are difficult to estimate. The debate on choice between energy efficiency and renewable energy is far from settled and decisions continue to be made void of empirical evidence.

This paper estimates the reduction in energy consumption, emissions and economy wide impacts on employment and income over time due to promotion of efficient household appliances in the Indian context. We then estimate the investment (and associated emissions) required to meet the equivalent energy demand through conventional and renewable sources if the energy efficiency measures were not deployed.

This method helps to quantify the monetary and environmental benefits of efficiency improvements programs in relation to other popular choices. The impacts of these alternative policy scenarios are estimated based on their economy wide impacts using a coupled input-output econometric framework of the newly developed E3-India model. The model captures the relationship between Economy, Energy and Emissions, covering 20 economic sectors and five income quintiles for India's 27 states

Applying of technological coefficients in long-term forecasting

Topic:

Author: Alsu SAYAPOVA

Co-Authors: Artem Vitalevich Orlov, Tatiana O. TAGAEVA

The complexity of developing long-term forecasts naturally engenders a variety of approaches to the solution of problems which are to be solved in the framework of preparing such forecasts. Expert opinions are considered as the predominant approach, and so output information have few quantitative estimates. But are quantitative methods and empirical numerical tool are so unpromising in assessing long-term economic development? After all, the basis of long-term projections is estimates of future technologies. The latter, as is known, are characterized by nothing but a set of technological coefficients. For this reason, in our opinion, the analysis of the dynamics of technological coefficients on the basis of the time series of input-output tables can assist in the evaluation of the shapes of future technologies. In this paper we performed a comparative analysis of the dynamics of homogeneous technological coefficients in different countries establishing their relationship. As an example, we can mention coefficients of “research intensity” in the various sectors of the economy, dynamics analysis and assessment of the prospects which are an integral part of technological forecasts. Another group of technological coefficients which is also addressed in the study concerns the “resource intensity” of individual sectors of Russia’s partner countries. Research is carried out on the basis of WIOD database.

Key words: technological coefficients, forecasting

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Prices and income distributions in Miyazawa models

Topic: (6.1) Special Session: Income distribution in IO models: Miyazawa revisited (1)

Author: Mònica SERRANO

Co-Authors: Albert E. STEENGE

Miyazawa's work (Miyazawa, 1976) played an important role in linking income distribution impacts to input-output systems. His work opened the door to study income distribution mechanisms in an input-output framework by endogenizing consumption bundles of specific income groups. The resulted multiplier matrices allow analyzing how shifts in final demand may affect different income groups. In other words, by linking the demographic and economic parts of an economy, revealed the effects of changes in economic actions on income distributions.

However, in a Miyazawa context the role of prices and price formation in studying income distribution problem has not been addressed satisfactorily up to now. This paper addresses the gap in the existing input-output literature regarding this issue. We present a theoretical basis for obtaining equilibrium prices in Miyazawa type models and explain how these can help us to analyze shifts in income distribution following exogenous impulses. The proposed method thereby closes a persistent gap in input-output methodology.

Carbon footprint mitigation of Japanese households for achieving the Paris Agreement under the demographic and income scenarios

Topic: (10.3) Input-output analysis for policy making (5)

Author: Yosuke SHIGETOMI

Co-Authors: Keisuke NANSAI, Shigemi KAGAWA, Susumu Tohno

In 2015, the Paris Agreement was ratified by 197 countries in order to strengthen the global response to the threat of climate change by keeping the global temperature rise below 2 degrees Celsius above pre-industrial levels (UNFCCC, 2016). In line with this agreement, the government of Japan determined to reduce 26% of territorial greenhouse gas (GHG) emissions at the 2013 level by 2030. The government also introduced a set of policies, "A Society in Which All Citizens are Dynamically Engaged," which aim to overcome barriers to economic growth by improving the birth rate and employment. It would be expected, however, that increases in population and household income will lead to the boost in the GHG emissions associated with household consumptions (e.g., Wier et al., 2001). This study estimated the impact of "Dynamically Engaged Citizens" policies on the carbon footprint of Japanese households in 2030 with a focus on structural changes in the population, household, and employment. This study further investigated the trade-off between the economic policies and the Paris Agreement target. For the policy-based footprinting analysis, this study used the Environmentally Extended Input-Output Table, National Survey of Family Income and Expenditure (NSFIE) and the population statistics of Japan. From the results, we found that the domestic carbon footprint of households in the economic policy scenario is estimated to be 6.0% larger than that of the BaU scenario showing that future household structure and consumption patterns are fixed at the current level. We conclude that Japan would need an additional 6.0% reduction of the household carbon footprint in 2030 in order to meet the Paris mitigation target, considering that the economic policy (i.e., "Dynamically Engaged Citizens" policies) will affect the structure of household expenditures due to increases in the number of children and the share of double-income households.

Role of World Structural Change in CO2 Emissions

Topic: (5.3) International Trade (2)

Author: Kayoko SHIRONITTA

Co-Authors: Sangwon SUH, Shunsuke OKAMOTO, Shigemi KAGAWA

Recent studies using the environmentally-extended multi-regional input-output (MRIO) models focused on the increasing role of international trade in global CO2 emissions (Peters and Hertwich, 2008; Peters et al., 2011). Under the decreasing cost of international trade and increasing vertical specialization, however, the global economy is increasingly operating as a single entity, and the emphasis on international trade may misdirect attention to the symptoms from the causes of global changes and their implications for CO2 emissions. In this study, we used a two-tier approach to analyze the role of underlying drivers in global CO2 emission changes over the last two decades. First, we aggregated the World Input-Output Database (WIOD) into a single-region global input-output (SGIO) model and decomposed the changes in global CO2 emissions over the last two decades into underlying changes in (1) population, per capita consumption (2) volume and (3) composition (in both, distinguishing between low-, mid-, and high-income countries), (4) global economic structure, (5) energy intensity of production, and (6) carbon intensity of energy use. Structural decomposition analysis (SDA) was used to quantify the contributions by these underlying drivers to the changes in CO2 emissions. Second, major drivers identified using SGIO were further decomposed into more detailed, regional-level changes using WIOD. Our analysis highlights the importance of global-level changes such as the growing middle class and global economic structural change for explaining changes in global CO2 emissions.

Policy-oriented Input-Output calculations for decisions of the government and business in Russia (experience of IEF RAS).

Topic: (1.2) Special Session: Input-output approach and impacts of economic policy in the emerging markets (1)

Author: Alexander Shirov

The research question

Transformation of the Russian economy is still far from completion. It means that economic dynamics is affected by changes in the structure of production, incomes and prices. At present moment Russia is faced with the choice of the new economic policy in many areas: demography, investments, foreign trade, energy sector etc. Therefore all economic agents need estimate of economic policy effects as at the macro-level; as at sectoral, regional and institutional levels such estimates are hard to make in current conditions of high differentiation of economy by factors of growth rather difficult. Development of toolkit of the complex analysis and forecasting is necessary for the solution of practical tasks in the field of economic policy.

The method used

Structure of the Russian economy requires development of models with use of I-O approach. But one model is not enough for the solution of all range of tasks. Complex I-O models, capable to complement each others, are required for such a task. Current system of I-O calculations developed and used in Institute Economic forecasting RAS (IEF RAS) includes dynamics I-O model, balance-based I-O model and multiplier effects model. Each of them solves the circle of problems.

Russian Interindustry Model (RIM) is dynamic INFORUM-type model which represents the top-level of modeling process, defining the main parameters of the forecast and forming key long-term restrictions for economic development.

I-O model CONTO used for creation more specific and detailed forecasts for mid-term prospect. In this model monetary, tax and foreign trade blocks are described in details. The model CONTO also allows to make forecasts for more than 80 regions of Russian Federation.

The model of multipliers allows to receive quick estimates of effects from large investment projects as at the macroeconomic level as at regional level. Current version of this model allows to estimate effects of the international projects (for example in energy sector).

The methodology of forecasting of dynamic and structural characteristics of the Russian economy with use of a complex of the I-O models developed in IEF RAS can be of considerable interest.

The data used

All models of IEF RAS based on actual official statistics and computed I-O tables for Russia in current and constant prices for 1980-2013.

The novelty of the research.

The system of calculations on the basis of tables which allows to solve practical problems is created. This system is demanded not only by expert community and the government, but also by business and is used as the instrument of coordination of economic policy and in case of decision making on implementation of large investment projects.

Technology Transfer and productivity growth- evidence from Indian manufacturing industries

Topic: (6.3) Energy Input-Output Modeling (2)

Author: Chandrima SIKDAR

Co-Authors: Kakali MUKHOPADHYAY

The importance of international technology transfer (ITT) for economic development can hardly be overstated. The acquisition of technology and its diffusion foster productivity growth. Developing countries across the world have relied largely on import of technologies from developed countries for driving their technological change. India too has been no exception. The country has had a fairly long history of acquiring technology from abroad. With the adoption of the New Economic Policy in early nineties, the Government of India put much focus on ITT with the expectation that it would result in the technological upgradation of the country's industries and hence lead to improvement in their international competitiveness. The policies to facilitate such ITT have been aligned and realigned by the government time and again over the past few decades in response to the particular needs of the industries, the supply position of technology and the overall philosophy of development of the country.

Against this backdrop, the present paper seeks to evaluate the extent to which international technology transfer may have led to productivity growth at the industry level in India, with particular focus on manufacturing industry. There are many channels through which ITT happens. The present paper focusses on imports as a significant mechanism for acquiring knowledge from international markets. Both import of knowledge as well as import of capital goods and inputs may result in productivity growth in the importing country. Productivity growth is a function of local stock of knowledge. Thus, import of knowledge which adds to the local pool of knowledge is likely to increase productivity. Likewise, import of capital and intermediate goods and their usage brings with them the embodied technology and R&D of the foreign country leading to productivity gain of the importing country. The present paper uses these imports along with foreign direct investment to assess the role of such technology transfer in promoting productivity growth in Indian manufacturing.

Based on data from the Annual Survey of Industries published by Central Statistical Organization (CSO) of India and Centre for Monitoring Indian Economy (CMIE) database, a panel regression is run for Indian manufacturing firms. The results obtained show that import of knowledge have been a very important determinant of productivity growth among the manufacturing industries in India. Based on this result, the paper focuses further on assessing how much import of knowledge as a source of technology transfer has led to productivity growth in Indian manufacturing. For this the inter industry supply chains are estimated using input-output (IO) tables of India that CSO publishes at regular intervals and the own sector imports and downstream imports of a sector are calculated. Using the downstream import figures as a determinant the industry level productivity growth due to import of knowledge is estimated. The detailed panel data analysis shows that firms in industries supplying import-intensive sectors have higher productivity than other firms. This finding suggests that linkages through vertical supply relationships are the channel through which import-driven technology transfer occurs.

The distribution of labor and wages embodied in European consumption

Topic: (1.7) Sustainable production and consumption

Author: Moana Simas

Co-Authors: Richard WOOD

The last two decades represented a substantial increase in the volume of products and services traded internationally. Production chains became spread all over the world, leading to a new division of labor, where management, production, and resource extraction can happen in substantially different places on Earth. In a third of a century, between 1980 and 2014, imports worldwide have increased over five-fold, mainly driven by imports to high income countries. Industrialized countries have gradually become net importers of environmental pressures, such as greenhouse gas emissions, energy, materials, and water, but also of labor. This occurs mainly because these countries' economies have gone through a shift towards a service-based and high-value-added economy, while increasing the imports of low-value-added and labor- and energy-intensive products. Consumption of goods and services per capita, at the same time, has increased substantially, generating the externalization of many environmental and social impacts to less developed countries.

The study of socioeconomic footprints from a global perspective is still a new subject. While input-output studies involving social and economic factors such as total labor, skilled labour or value added are a tradition in economic assessments (for example, early studies by Leontief have already examined total and skilled labour associated with exports in the U.S.), they have often focused on impacts in national economies. Social analysis of global production and consumption systems have just recently started gaining space in the footprinting field, with the incorporation of social extensions in environmentally-extended multiregional economic models and a growing interest in assessing social impacts embodied in international supply chains. In this study we quantify socioeconomic impacts happening throughout the globe generated by European household consumption of food products, clothes, and electronics. We present an analysis of the origins of workers and salaries embodied these products, as well as the location of workers in most vulnerable situation. We used a multiregional input-output (MRIO) model, EXIOBASE, and its socioeconomic extensions, to quantify labor and wages footprints for Europe (EU-28 plus Norway and Switzerland) throughout the period between 1995 and 2015. The region demands over one third of global imports.

The consumption of goods in Europe creates millions of jobs within and outside the EU, most of them in the supply chain of food products. Wages are concentrated in the European Union, with

over three-quarters of wages paid to workers that live within the EU, whilst 68% of total employment and 82% of all workers in vulnerable conditions associated with EU consumption took place outside the region. Food products, for example, occupied 16% of the average EU household budget and accounted for about the same share in wages footprints but corresponded to over 40% of employment footprint and almost 50% of all workers in vulnerable condition. We have seen that over time, there has been a strong growth in outsourcing, particularly recently in clothes and electronics, noticeable by a decrease in EU wages footprint at the same time as the footprint for wages and workers outside the EU increased more intensively. For food production, most of this outsourcing appears to have taken place before 1995. The shock of the financial crisis, which saw a much bigger drop in employment impacts outside the EU, also shows the dependency problem that is created for poorer regions that specialize in exports to industrialized countries.

Is outsourcing decreasing gains in greenhouse gas efficiency in developed nations? A decomposition of energy and labor embodied in trade between 1995 and 2015

Topic: (5.3) International Trade (2)

Author: Moana Simas

Co-Authors: Edgar G. Hertwich, Richard WOOD

In an ideal scenario, international trade could be capable of allocating production to the most appropriate locations in terms of the efficient use of capital, technology and resources, thus effectively reduce environmental impacts of production. This has not been the case and we might be far from the ideal scenario. The shift in production and the globalization of supply chains have not decreased global environmental pressures such as greenhouse gas (GHG) emissions so far. On the contrary, not only emissions have increased worldwide, but emissions embodied in trade have increased faster than global gross domestic product (GDP), mainly due to emissions embodied in traded products between developing and developed countries. This is especially the case for the years leading to the global financial crisis, when emissions from developing countries (especially China) grew rapidly between 2000 and 2007. Although the world economic recovery signalizes to a shift in the trade relations and in the carbon embodied in traded goods worldwide, with an increase in the South-South trade, the path for future emissions is still highly dependent on the policies adopted in the next years. One of the concerns with the growing emissions embodied in trade is that of carbon leakage. Although there hasn't been found much evidence of a strong carbon leakage - i.e. increase of emissions in developing countries caused by the adoption of climate policies in developed countries - the growth of emissions transfers between countries has been argued to be driven mainly by economic factors.

In the past decades, advances in information and communications technology, in transportation and growing trade openness have allowed for a strong rupture in the regional links between production and consumption. Although global supply chains have existed for centuries, it was in the past decades that the offshoring of manufacturing to resource-abundant countries have increased substantially. Today, finished and unfinished products are transported globally in unprecedented cost and speed. In this context, labor costs have been assumed to be an important driver to the migration of manufacturing stages, especially those characterized for high labor intensity such as textiles and clothing, from capital-abundant economies to labor-abundant regions. Nevertheless, labor-abundant regions tend to present lower energy productivity. The relocation of manufacturing stages can thus lead to an overall increase in energy consumption and, ultimately, trim down the impacts of GHG reductions in developed countries.

In this study we aim to quantify the relationship between labor costs, outsourcing and the further

effects on environment. We look at the drivers for changes in total labor footprints and how labor and energy have been allocated between industries and countries between 1995 and 2015, as well as its relationship to the growth of GHG emissions embodied in trade, with special detail to industries that present higher shift in production location. We also perform a structural decomposition analysis (SDA) to understand the contribution of the shift in production between countries - what we here call outsourcing - to global relocation of labor, labor costs and energy and to the growth in carbon footprints. We used EXIOBASE, a high-resolution macroeconomic model which details the flows of products in the world economy, coupled with socioeconomic and environmental pressure indicators. In the recently developed version 3, EXIOBASE details the global monetary flows between the production of 200 goods and services in 44 countries and five "Rest-of-the-World" (RoW) regions for every year between 1995-2011 and nowcasted to 2015. The 44 countries in the model comprise, together, for 86% of global GDP in 2015 (91% in 1995). Preliminary results show that outsourcing is an important driver for the emission growth in developed regions, offsetting gains in technology efficiency, while increased affluence is the main driver for emission growth in developing economies.

Investment in Health Sectors: Economic Impact using Input Output Analysis

Topic: (3.2) Impact Analysis: Multipliers (1)

Author: Anushree SINHA

Co-Authors: Mihir Milind Wadekar

Background/Objective

In a very important initiative to revise the health policy in 2013 by introducing the National Urban Health Mission (NUHM) as a Sub-mission of an over-arching National Health Mission (NHM), with National Rural Health Mission (NRHM) being the other Sub-mission of National Health Mission. There is no systematically examined the distribution of medical expenses by types of households in India. The major objective of the paper is to use Input-Output analysis to quantitatively estimate economic impact of investment on health sectors and examine its range with sensitivity analysis. Using the latest input output table (2012-13) and the 71st Round of the National Sample Survey data we attempt to analyse the impact of investment on health sector on different types of households.

Data

Input-Output 2010-11 from CSO India updated to 2012-13 by NCAER. NSS health survey (2013-14), data collected had enabled assessment of the role of medicine in respect of prevalence of use, cost of treatment and type of ailments covered. Using the latest input output table and the 71st Round of the NSSO we attempt to analyse the impact of investment on health sector on different types of households. The survey aimed to generate basic quantitative information on the health sector. Measurement of the extent of use of health services provided by the Government was also part of this exercise. Special attention was given to hospitalisation, or medical care received as in-patient of medical institutions. Emphasis was laid on collecting information on 'out of pocket' expenditure for various episodes of illness. For most important parameters, the survey provided estimates separately for males and females. Special attention was given to hospitalisation, or medical care received as in-patient of medical institutions. Emphasis was laid on collecting information on 'out of pocket' expenditure for various episodes of illness. Also we use NSSO 67th Round on UNINCORPORATED NON-AGRICULTURAL ENTERPRISES (EXCLUDING CONSTRUCTION). Given this rich data set we disaggregate the health consumption by workers differentiated by gender. These workers are also identified across types of sectors and also then mapped to various classes of households.

Method

We have aggregated the latest IO table from 130 sectors first to 10 sectors that focus on women's employment and then disaggregate the medical sector into Medical Package, Doctor's/ surgeon's fee, Medicines Diagnostic Test, Bed Charges, and Other medical expenses. We get the shares of production and intermediate requirements of the new health sectors by using the NSSO 67th Round on Unincorporated Non-agricultural Enterprises (excluding Construction).

Thus the 15 sectors are proposed to be:

1)Agriculture , 2)Mining & Quarrying , 3)Food Processing, 4)Textile Sector , 5)Other Manufacturing , 6)Capital Goods, 7)Construction, 8)Medical Packages, 9)Doctor Services, 10)Medicines, 11)Diagnostic, 12)Hospital Beds, 13)Other medical services, 14)Other Services and 15)Public Administration.

The consumption of health sectors are further disaggregated by sectoral workers distinguished as: Own Account Workers, Regular Wage Worker, Casual Labor and Others and further by gender. We also map the workers to three types of households: Rich. Middle and poor based on per capita monthly expenditure information.

Expected Outcome

We propose that the contribution to medical care should be evaluated more explicitly in national medical care expenditure policies. We also examine the prevalence of health problems of workers distinguished by type of work and sector.

Endogenising capital in MRIO models: implications for consumption-based carbon footprints

Topic: (6.2) Environmental IO modelling (4)

Author: Carl-Johan H. SÖDERSTEN

Co-Authors: Richard WOOD, Edgar Hertwich

Carbon footprints track the cumulated greenhouse gas emissions that occur throughout the supply chain of a product. Input output analysis is becoming increasingly popular within environmental research fields such as Industrial Ecology and has become the tool of choice for performing footprint-type impact assessments. Several global multi-regional input output (MRIO) databases have been developed in recent years, allowing practitioners to trace emissions embodied in products and thereby assigning the emissions to end consumers rather than emitters. One challenge is that these databases typically treat gross fixed capital formation as an end consumer, despite that fixed capital, e.g. infrastructure, machinery, etc., is ultimately consumed by industries to produce more goods and services destined for final consumption. Therefore, traditional consumption-based impact calculations do not account for the environmental impacts embedded in the capital goods used in the production processes. This has large implications for a country like China, whose carbon footprint has tripled in the last twenty years, largely due to a huge increase in investments needed to produce goods for export.

In this work, we apply the flow matrix method to endogenise capital transactions in the inter-industry matrices by combining the EXIOBASE3 database with detailed capital consumption matrices from other sources such as the KLEMS, WORLDKLEMS and national statistical office databases. We endogenise the consumption of fixed capital, disaggregating the product/sector level detail to the EXIOBASE classification, and compile new MRIO tables that we use to calculate consumption-based impacts that account for the capital that is used in production processes. Further, we use the EEBT approach to estimate the capital emissions embodied in actually traded goods and services. We find that for most countries, the gap between production-based and

consumption-based emissions is increased further when capital goods are taken into account, and that the amplitude of this increase varies a lot across countries. We also find that endogenising capital leads to substantial changes in both volume and product mix when looking at the emissions embodied in bilateral trade.

Making a Village Input-Output Table (VIOT) from Household Survey A case study of Phonxay Village of Ngoi District, Luang Prabang Province, Lao PDR.

Topic: (5.2) Input-output analysis for policy making (2)

Author: HONGSAKHONE XAY SOULIXAY

Co-Authors: Masaru Ichihashi

"Making a Village Input-Output Table from Household Survey - A case study of a rural village in Lao PDR"

Soulixay HONGSAKHONE , Masaru ICHIHASHI and Yuichiro YOSHIDA

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Abstract

This paper shows a main result of the first trial of making a Village Input-Output Table (VIOT) utilizing the 2015 Household Survey data conducted in a rural poor village of Ngoi district, Luang Prabang Province, and Lao PDR and it also presents main results of the analysis. The main purpose of this research is to examine and capture the inter-dependency between households and their economic activities. The outline of VIOT is based on the classification of the sectors by household economic activities in a matrix of 1240 x 1240 dimensions. This VIOT represents the relationships of purchases and sales of 10 products between all households in the village. It can be an appropriate tool to grip socio-economic transaction among key sectors in isolated village or disadvantageous areas in developing country. The result of VIOT shows the minimum inter-dependency among households with a total output multiplier of 1.767, indicating most households are depending on outside sources for the production and livelihood. However, the backward linkage analysis has revealed that poor households tend to buy more products from other non-poor households, while forward linkage analysis shows that, non-poor households, especially the last 4 rich households, tend to sell more products to poor households. This study would be, so far, the first trial of making a village Input-Output table based on micro-household survey data of isolated area in developing country.

Keywords: Village Input-Output Table; Poverty Measurement, Backward and Forward linkage analysis.

JEL: D57; R15; I32; O13.

Variable Resource Stock Availability and Reserve Capacity Over Time: Toward a Dynamic Rectangular Choice-of-Technologies Model

Topic: (2.5) Special Session: Modelling Sustainable Development: Revisiting Dynamic Input-Output Analysis

Author: Nathaniel Paul Springer

Abstract: Assuring a stable and affordable supply of natural resources is an essential condition for maintaining and improving global economic security and long-term global sustainability. Yet as known endowments are utilized and existing reserves are drawn down, existing or increasing demand must be 1) extracted at a faster rate 2) replaced by accessible new reserves 3) substituted with other resources, all three which likely require investment and the application of technologies previously not developed or applied in the endowed region. It remains unclear how this continued or increased resource use over time will affect long-term sustainable resource access and prices. This paper explores this research question by creating an expansion of the Rectangular Choice-of-Technologies (RCOT) model (Duchin and Levine 2011) to include the dynamics of resource endowment use, capacity investment, and technological utilization. It builds upon the existing dynamic input-output model proposed by Duchin and Szyld (1985), utilizes the distinction between resource and reserve grades defined in Springer (2017), and expands the current linear programming (LP) basis for RCOT to include recursive time-steps (Day 1967). I then apply this dynamic RCOT model to the case of future global phosphate ore extraction. The scenario results, showing regional and globally averaged phosphate ore extraction over time, illustrate the usefulness of this approach for determining the future availability and cost of natural resource extraction (compared to alternative approaches such as Hubbert curves).

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Note: This talk is for the special session "Modeling Sustainable Development: Revisiting Dynamic Input-Output Analysis".

Distinguishing Co-products and Waste using the Rectangular Choice-of-Technologies Model: The Role of Prices

Topic: (4.4) Special Session: Building a Circular Economy: Assessing the Sustainability of New Technologies for Material Recovery and Waste Cycling

Author: Nathaniel Paul Springer

Co-Authors: Jennifer Schmitt

The reuse or sale of co-products that are the byproduct of main production processes is widespread throughout the global economy. Yet there remain many opportunities to increase this recovery and reuse of byproducts, moving away from linear disposable supply chains to circular recovery supply networks. Many of unused byproducts are deemed waste while the used byproducts are deemed co-products; in reality, the difference between them is the technological and economic capacity to utilize them. How can this subtle dichotomy between co-products and waste be resolved?

Using the Rectangular Choice-of-Technologies (RCOT) framework (Duchin and Levine, 2011), this paper first presents an approach for associating co-products/waste with the production process of a specific commodity and technology. This method, which uses physical input-output data in the primal of the RCOT linear program, has previously been developed to model the co-product "distiller dried grain with solubles", or DDGS, associated with ethanol production that is subsequently used as feed for livestock. This paper proceeds to connect this physical production quantity of co-products/waste in the primal solution with the financial price of co-products/waste in the dual solution. By comparing the prices of utilized co-products to unused wastes, this framework provides an explicit way to define these two concepts while also illustrating how changing costs and technologies can change wastes into co-products, and vice-versa. A hypothetical numerical example is presented for illustrative purposes.

Duchin, F., and S. Levine. 2011. "Sectors May Use Multiple Technologies Simultaneously: The Rectangular Choice-of-Technology Model with Binding Factor Constraints." *Economic Systems Research* 23 (3): 281-302. doi:10.1080/09535314.2011.571238.

Note: This talk is for the special session "Building a Circular Economy: Assessing the Sustainability of New Technologies for Material Recovery and Waste Cycling".

Decomposition Analysis of Sources of Economic Growth in Russia Based on Russian Input-Output Tables

Topic: (10.6) Structural Decomposition Analysis

Author: Elena Alekseevna Staritsyna

Co-Authors: Eduard Filaretovich Baranov, Anna Elsakova, Evgeniya Korneva

This paper considers the structural decomposition approach which identifies the sources of dynamic changes in output and import. With the lack of official Russian Input-Output Tables for analysis we use the time series of symmetrical input-output tables for Russia based on NACE rev. 1 classification from WIOD project. Then we deflate these current price tables in prices of 2008 year. The results of the analysis enable us to determine the influence of changes in technology (intermediate demand) and final demand on the increase or decrease of the value of output and imports at the level of 34 industries and in the whole economy for the period from 2003 to 2010. For the final demand we also estimate the contribution to the changes in the final demands

between two periods (1) the final-demand level; (2) the distribution of total expenditure across final-demand categories and (3) the product mix. Due to the lack of statistics, many a priori assumptions were used in the construction of Input-Output tables at current and constant prices; therefore, the estimates obtained from our calculations are illustrative. Nevertheless, the general policy conclusions from this analysis to a certain extent can be considered reliable. The period from 2003 to 2010 in the Russian economy was characterized by important measuring features of the dynamics of production. Some of these features include structural changes in the industry and the resource-saving reflecting the transformational nature of the Russian economy, as well as the increase in the share of imports of goods and services in the structure of the intermediate and final demand. The growth in investment demand for machinery and equipment is fully covered by imports. Among the factors that contribute to changes in final demands between 2003 and 2010 decisive role belongs to final-demand level.

Endogenizing Prices in Extended IO Models including Natural Resources

Topic: (9.1) Special Session: Income Distribution in IO Models: Miyazawa Revisited (2)

Author: Albert E. STEENGE

Co-Authors: Andre Carrascal, Mònica SERRANO

Extended Input-Output models link the income earners with their own specific consumption profile, showing part of the circular flow of income. However, these models consider prices as exogenous, independently if they incorporate demographic characteristics or not. Prices are key parameters in order to estimate the rents obtained in the production process, especially when natural resources like land or water are included in the model. In this specific case, the owners of the production factors (labor, capital, land, water, etc.) correspond with the categories of households. The aim of this paper is to assess how the income distribution is affected by endogenizing prices and rents of the different primary inputs. This article attempts to cover the current gap in the Input-Output literature regarding this topic. Hence, the formulation presented here can be interpreted as a first step in the construction of a theory of value and income distribution following Miyazawa framework, including associated prices and price behavior.

Keywords: Prices, Extended Input-Output model, Income distribution, Production factors

Assessing the localised socioeconomic impact of central government policy

Topic: (2.7) Input-output analysis for policy making (1)

Author: Jonathan Stenning

Co-Authors: Michael May-Gillings, Hector B. POLLITT

Central government policymakers are often concerned primarily with the net socioeconomic impacts of policy at a national level. However, policies can have extremely local impacts; energy policy particularly can have major implications for a small number of large plants, and therefore have substantial implications for the local economy around each site.

This paper assesses the largest localised socioeconomic impacts of changes to the UK's carbon price floor. We apply a modelling approach, based on simulation properties, that allows for a combination of bottom-up modelling of the power sector and top-down models of the economy

(and the interactions between the energy system, the economy and the environment). The global E3ME macro-econometric model (www.e3me.com) is coupled to the Future Technology Transitions (FTT) modelling framework for the power and road transport sectors, and the outputs used to shape local area outcomes captured in the LEFM model. This approach is qualitatively different from the optimisation tools that are used in other analyses and draws on theories from post-Keynesian and evolutionary economics. Instead of trying to find least-cost pathways, the model simulates the responses to policy inputs (including market-based instruments) and is parameterized on real-world time-series data.

E3ME is used to capture the national-level effects of policy, including second-order and international trade impacts, while the LEFM framework is then applied to estimate the manner in which these effects cycle through the local economy, focussing primarily upon the severe demand-side shock to the economy from the closure of coal-fired power plants and the subsequent impacts that this has on the local economy, modelled through an input-output framework with adjustments for local supply content. This presents, using the UK as an example, the potential for using similar local area models, linked to a global model such as E3ME, to estimate regional or local impacts of national or international policy in any country.

Introduction to the E3-India model

Topic: (5.6) Special Session: Shifting Scales of Macro-econometric Modelling to State-Level Economic, Energy and Environmental Policy Analysis for India(E3-India)

Author: Jonathan Stenning

Co-Authors: Hector B. POLLITT

Organized Sessions

Session Organiser: Kakali Mukhopadhyay, Department of Agricultural Economics McGill University, and Gokhale Institute of Politics and Economics, Pune, India

Session Chair: Kakali Mukhopadhyay, Department of Agricultural Economics McGill University, and Gokhale Institute of Politics and Economics, Pune, India

Title: Introduction to the E3-India model

Presenter: Jon Stenning, Cambridge Econometrics

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Abstract: E3-India is a new state-level model of India, developed from the global E3ME macro-econometric model, linking the economic, energy and environmental emissions systems. The model is designed to assess energy and climate policy through a highly empirical structure, whereby historical data is used to feed in to econometric estimations of model interactions, forming a consistent modelling framework. Policies can be introduced into this framework at a state level, and the energy system and economic impacts assessed both within that state and (through trade) spillovers into other states.

The model is macro-econometric in nature, based on a post-Keynesian framework within which optimisation is not assumed (i.e. it is not a general equilibrium model). Through accounting identities, demand must equal supply, but demand can be less than or equal to total potential supply; the implication of this framework is that, under the right conditions, it is possible for regulation to increase output and employment.

E3-India also includes explicit treatment of technology, using the Future Technology Transitions (FTT) modelling framework for the power sector. This approach is qualitatively different from the optimisation tools that are used in other analyses and draws on theories from post-Keynesian and evolutionary economics. Instead of trying to find least-cost pathways, the model simulates the responses to policy inputs (including both regulation and market-based instruments) and is parameterized on real-world time-series data.

Implications of Emerging Protectionism of the U.S. on Climate Change

Topic: (10.4) Environmental IO modeling and CO2 Emission

Author: Sangwon SUH

Co-Authors: Bernhard MICHEL, Rutger HOEKSTRA

International trade environment is rapidly changing: mega-regional trade negotiations such as Trans-Pacific Partnership (TPP) are underway, while at the same time the protectionism of the U.S. is rising. How such changes would influence global CO2 emissions? In our previous paper, we identified that high-wage countries' decisions to source from low-wage countries as the major contributor to the increase in global CO2 emissions associated with sourcing. Using Structural Decomposition Analysis (SDA), this paper examines the changes in global CO2 emissions due to international sourcing before and after two major events that significantly changed the patterns of international trade in recent decades: (1) China's accession to the World Trade Organization (WTO) in 2001, and (2) the global financial crisis in 2007. We then try to relate the SDA results to today's emerging international trade environment. Our SDA results clearly show that the majority of the increase in CO2 emissions due to sourcing between 2001 and 2007 can be explained by the carbon intensity disparity between high and low-wage countries, and the rapid increase in trade volume after the accession of China to WTO. This led to a dramatic increase in GHG emissions due to international sourcing. During and right after the 2007 global financial crisis, however, the volume of international trade between high and low-wage countries plunged. This phenomenon alone, however, did not reduce CO2 emissions due to sourcing. Instead, it led to an unprecedented, nearly 1 Gt CO2 emission increase by the changes in China's sourcing pattern between 2007 and 2009. This, seemingly counterintuitive result too, however, can be explained by the carbon intensity disparity between high and low-wage countries; not only high-income countries but also low-income countries had to cut their imports from the other, and low-wage countries had to reduce their imports from high-income countries more significantly during this period. As reduced imports from high-wage countries are displaced by carbon intensive domestic supplies, CO2 emissions due to the changes in sourcing patterns increased. This period coincides with the times when China enjoyed the largest international trade surplus. Our results imply that the potential reduction in trade volume due to the emerging protectionism of the U.S. does not automatically translate into a reduction in CO2 emissions from sourcing. If low-wage countries respond to high-wage countries' protectionism by replacing imports from high-wage countries by the supplies from domestic sources or from other carbon intensive countries, the global economy is likely to witness an increase—not a decrease—in CO2 emissions due to sourcing.

Inter-Sector Inter-Region Model for Russian Economy: Methodology and Application

Topic: (1.2) Special Session: Input-output approach and impacts of economic policy in the emerging markets (1)

Author: Nikita I. SUSLOV

Co-Authors: Vladimir BUZULUTSKOV

The paper presented is intended to analyze an approach to a long-term inter-sector and inter-regional economic analysis as based on an optimization model. This approach was developed in IEIE SB RAS and resulted in several directions of application. One of them is investigation of interactions between a national economy and its energy production segment. The model being discussed includes input-output tables for six regions of Russian economy supplemented with model blocks for interregional transportations. It includes a natural block of energy production, processing and transportation. The last version of this model 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.

Modern versions of OMMM are based on the following statistical data:

- Aggregated Input-Output Tables for the Russian national economy for each year from 1995 up to 2004 which include 20 sector products;
- tables of goods and services consumed in Russia (in consumer prices of next year) which include 20 sector products,
- Russian National Input-Output Table for 1995 which includes more than 100 sector products, and
- other statistics provided by the Russian Statistics (ROSSTAT).

There are certain difficulty in calculating regional input-output tables. Unfortunately, neither ROSSTAT, nor regional statistical bodies have started with issue such data since the beginning of the economic reforms, at least in regularly and in complete patterns. That is why we, since the end of 1980s, have to adjust regional differences of input coefficients to update current regional IO tables. For this purpose we apply certain kinds of RAS methods.

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;
- efficiency of using and spreading RES technologies in different regions of Russian economy;
- forcing of Siberian gas and coal out from international energy markets.

We consider the novelty of the paper presented as, first, critical comparison of analytical strength of the model of the type we deal to analytical strength and options of MRIO analysis. Secondly, we apply the model to evaluate economic consequences and efficiency of spreading both sorption air conditioning and sorption cooling technologies which are essentially less demanded

for energy use with respect to traditional compression engines but much more capital intensive.

Transatlantic Trade and Investment Partnership (TTIP) and Pakistan- A Global Commutable General Equilibrium Approach

Topic: (8.4) International Trade (3)

Author: Alishba Tahir

Co-Authors: Muhammad Aamir KHAN

Transatlantic Trade and Investment Partnership (TTIP) is a mega trade deal between European Union and United States, insuring free trade between the two regions. While this agreement is expected to facilitate trade among the member economies, other countries in the region that are left out of the agreement, such as Pakistan, are likely to be adversely affected due to significant trade diversion. From the current facts and figures, it is accurate to say that both members of TTIP are the biggest trading partner of Pakistan. As EU holds the largest and significant share in its exports and imports following by USA, this trade deal will be proven unfriendly to Pakistan. On the other hand, Pakistan has been recently granted a Generalized Scheme of Preferences (GSP) Plus status by the European Union in December 2013. The status allows Pakistan commodities to access 500 million consumers, in 28 EU countries, with roughly the same tariff preferences in a single market. The immediate outcome of GSP Plus status is likely to increase in accessing EU market through the duty free import of GSP-eligible goods. This status will substantially increase Pakistani exports to the European markets especially Textile, Wearing Apparel and leather sectors. By using the Global CGE modelling, this study shows that TTIP will leave a negative impact on the macroeconomic level of Pakistan. Moreover, the real household incomes will reduce making it an unfavorable deal for a non-member country i.e. Pakistan. The GSP+ status would, however, overcome the negativities created by the TTIP in the economy of Pakistan. Nevertheless, under current GSP plus status, keeping in view the capping mechanism set by the European Parliament the scope for growth gets limited.

The Effects of Productivity Improvement on Global CO2 Emissions

Topic: (8.1) Productivity and efficiency analysis

Author: Hirotaka TAKAYABU

Co-Authors: Shigemi KAGAWA, Shunsuke MANAGI, Hidemichi FUJII

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 productivity. Productivity improvement decreases the ratio of input to output and thus contributes to the reduction in CO₂ emissions. An important question is how to estimate the productivity in a country.

The Data Envelopment Analysis (DEA) has been widely used to estimate productivity of Decision Making Units (DMUs). This methodology considers input and output factors used in the production process, and estimates productivity of DMUs in the sense that input factors are minimized while ensuring the quantities of output factors referring to the production frontier. Adopting this methodology, we can estimate the effect of productivity improvement on CO₂.

Firstly, this study identified the set of efficient production technologies (i.e., production frontier) of 14 metal sectors of EXIOBASE using the DEA framework considering domestic output as an output factor, and labor, capital stock, energy uses, electricity use and other intermediate input as input factors. Data of EXIOBASE of 40 countries in 2007 is applied. Then we estimated

consumption-based CO₂ emissions (i.e., carbon footprint of nations) using the actual multi-regional input-output tables and ones using the modified multi regional input-output tables that include efficient sectoral inputs estimated by the DEA.

From the results, we found that manufacture of basic iron and steel sector and copper sector are inefficient in some countries like China or India in the sense that those technologies can decrease inputs while ensuring their output quantities by shifting their inefficient production activities to the production frontier. We finally conclude that consumption-based emissions can reduce considerably by improving their productivity referring to the production frontiers of 14 metal sectors estimated by this study.

VERTICAL SPECIALIZATION IN INDIAN MANUFACTURING AND SERVICE SECTORS

Topic: (1.5) Global Value Chain and Vertical Specialization (1)

Author: Priyanka Tariyal

India is one of the fastest growing economies in Asia. This transition to the high economic growth path is widely believed to have been triggered by accelerated growth of services that has fared better than manufacturing, in terms of increasing sectoral share in gross domestic product (GDP) and total employment. The government of India is currently concerned with engineering further economic transformation and thus, has launched its “Make in India” national programme wherein, greater emphasis is being placed on foreign and local investments in 25 focus sectors to transform India into a global manufacturing powerhouse. Therefore, greater integration of domestic industries with global production networks must form an essential part of Make in India initiative. Against this backdrop the objective of this paper is to estimate the extent of integration of Indian manufacturing and service sector into the global value chains. There are various ways to measure the economic participation in global value chains and a more rigorous measure is vertical specialization. Using Koopman, Wang and Wie (2012,2014) Value Added in Trade method (VAiT), the study estimates domestic and foreign value added in exports to quantify the vertical specialization in India’s trade and subsequently Trade in Value Added method (TiVA) is used to calculate India’s value added trade disaggregated by industry. The calculations are based on recently published World Input Output Database (Timmer et al., 2016). We compare the data for first and final years available in WIOD, 2000 and 2014. For the purpose of analysis the WIOD countries have been combined other than India into 5 countries and two destination regions (the United States, China,

Korea, Japan, Taiwan, the European Union and Rest of the World). The findings suggest that from the policy perspective India should continue to reduce trade barriers to trade and FDI in goods and services having strong links with manufacturing sector.

A post-Keynesian multi-commodity and multi-industry growth model

Topic: (2.1) Special Session: Stock-flow consistent input-output modelling

Author: Umed TEMURSHOEV

This paper extends the Keynesian-Kaleckian growth macro-model prototype of Godley and Lavoie (2012, Chapter 11) to a mesoeconomic stock-flow consistent (SFC) setting that allows for multiple commodities and industries. Akin to the commodity-by-industry approach in input-output analysis, the number of commodities are allowed to be different from that of industries and as

such supply (or make) and use tables (SUTs), and not symmetric input-output tables which themselves are analytical constructs from SUTs, become an important data source in any empirical application of the proposed model. In dealing with secondary commodities (e.g. subsidiary products, by-products, joint products), the production block of the model allows for adopting different production technology assumptions (e.g. commodity technology, industry technology, or mixed technology). We derive the analytical short-run and long-run solutions of the model, and compare the results with their counterpart outcomes of the macro-SFC model. Finally, our simulation experiments give further insights into the transition dynamics of selected fiscal and monetary policy tools.

Distance-based shared responsibility

Topic: (4.1) Consumption-based accounts

Author: Umed TEMURSHOEV

Co-Authors: Ronald E MILLER

In operationalizing Gallego and Lenzen's (2005) upstream (downstream) shared producer-consumer (producer-worker) responsibility input-output model, Lenzen et al. (2007) (resp. Lenzen 2008) proposed pegging the required upstream (downstream) sharing parameters to value added (final demand) because this approximates the extent of producers' control over the production recipe (sales structure). In this paper we consider alternative distance-based choices for the sharing parameters. For the upstream responsibility we suggest approximating the sharing parameters by the inverse of sectors' average distance from their primary inputs providers in the input demand chain (Miller and Temurshoev 2015). The reasoning for such a choice coincides with that of Lenzen et al. (2007): if the distance between producer i and its primary inputs suppliers is small, then it must be the case that producer i adds significant value to the product in its production process compared to another producer k who is positioned much farther away from its providers of primary inputs. This implies that producer i has higher influence over production processes, hence should be levied with larger responsibility share. Similarly, for the downstream responsibility we propose as a proxy of the sharing parameters the inverse of sectors' average distance to their final users in the output supply chain (Antràs et al. 2012). The argument for such a choice is that the shorter the distance between producer i and its final users, the larger proportion of its output it sells to final demand, hence the higher influence it has over sales and advertising, and subsequently it should be levied with a larger share of downstream responsibility, which is also consistent with Lenzen's (2008) reasoning. In our empirical exercises we compare the distance-based shared responsibility outcomes with those where the sharing parameters are pegged to value added and final demand, and also analyze the sensitivity of the results with respect to (dis)aggregation.

Identifying High Resource Consumption Supply Chain Points: A Case Study in Automobile Production

Topic: (7.5) Input-output analysis for policy making (3)

Author: Douglas S Thomas

Co-Authors: Anand Mani Kandaswamy, Joshua Kneifel

The Pareto principle posits that roughly 80 % of a problem is due to 20 % of the causes, allowing for the targeting of specific efficiency solutions. This paper examines whether the resources used in production are consistent with this principle and then seeks to develop a method to identify

those supply chain entities that account for a disproportionately high level of resource consumption compared to other supply chain entities. A novel multi-factor approach is used where resources examined include time, cost, labor, environmental impact, and depreciable assets. The method utilizes data from the BEA 2007 Benchmark make and use tables, Annual Survey of Manufactures, Survey of Plant Capacity Utilization, Manufacturing Energy Consumption Survey, RS Means construction cost data, and an environmentally extended Input-Output database for Life Cycle Assessment (LCA). The approach facilitates the identification of economy-wide opportunities for efficiency improvement in manufacturing, a topic that has limited research devoted to it. Those production activities that consume high levels of resources provide a strong opportunity for efficiency improvement, affecting multiple stakeholders. This method is illustrated by examining automobile manufacturing as a case study. The results suggest that the cost distribution is consistent with the Pareto principle where 20 % of supply chain entities account for 89 %, 89 %, and 91 % of value added, labor hours, and environmental impacts from automobile manufacturing, respectively. Additionally, sixteen supply chain entities were above the 90th percentile in value added, environmental impact, and labor hours for automobile manufacturing, implying efficiency improvements could be obtained across multiple resources simultaneously. For those supply chain entities that would, traditionally, be considered a supplier (i.e., those that manufacture intermediate parts, components, and materials as opposed to those that provide services), the environmental impact, flow time, labor hours, and depreciable assets were above the 90th percentile for one supply chain entity and an additional two are above the 80th percentile.

China's Involvement in Global Value Chains: Trends and Drivers of Productivity and Activity Upgrading

Topic: (3.3) International Trade (1)

Author: Kailan TIAN

Co-Authors: Quanrun CHEN, Erik DIETZENBACHER, Cuihong YANG

Increasing productivity efficiency and engaging in more skill-intensive activities are two typical paths for industrial upgrading in Global Value Chains (GVCs). This paper examines the main trends of these two upgrading patterns for China using OECD Multi-Region Input-Output Tables and occupation data on jobs. Our results indicate an ongoing process for both productivity upgrading and activity upgrading in China. However, the upgrading performance would be less exceptional if we take into account processing trade (i.e. the activity of assembling tariff exempted imported inputs into final goods for resale in the foreign markets). We find that processing exporters are less productive than non-processing exporters, and non-processing trade production has superior performance in productivity upgrading and activity upgrading. At last, we use a structural decomposition method to account for the drivers of the upgrading process observed. Undoubtedly, the growth of employment engaged in processing trade production is driven by the growth of foreign final demand. In particular, technological changes in GVCs are also significant in explaining the upgrading process. Our analysis suggests that distinguishing between processing and non-processing trade production is crucial for measuring and understanding upgrading performance in China.

Wider economic impacts of heavy flooding in Germany: A non-linear programming approach

Topic: (4.2) Input-Output analysis of disasters

Author: Johannes TÖBBEN

Co-Authors: Jan OOSTERHAVEN

This paper further develops a new methodology to estimate the wider, indirect impacts of major disasters, and applies it to the 2013 heavy flooding of southern and eastern Germany. We model the attempts of economic actors to continue their usual activities, as closely as possible, by minimizing the information gain between the pre- and post-disaster pattern of economic transactions of the economy at hand. Our findings show that government support of local final demand substantially reduces the indirect losses of the floods, while having a disaster at the top of the business cycle increases them. Moreover, we find that assuming fixed trade origin shares and fixed industry market shares, as in all multi-regional input-output models, leads to implausibly large estimates of the indirect losses.

A Maximum Entropy Approach to the Hybridization of MRIOs for the Estimation of Biodiversity Footprints

Topic: (5.4) Industrial Ecology using IO Tables

Author: Johannes TÖBBEN

Co-Authors: Francesca Verones, Daniel Moran, Richard WOOD, Konstantin STADLER, Martin BRUCKNER

One of the biggest contributors to global biodiversity loss is land use and land use change, with agriculture being its single largest driver. Nowadays, many environmental footprint approaches connect socio-economic drivers to biodiversity impact through the mapping of supply chains using global multiregional input-output (MRIO) analysis. For calculating land use impacts on biodiversity, researchers have made great progress in mapping the distribution of agricultural activity and the corresponding change in land use, as well as the characterizing these changes in terms of threats to biodiversity at high spatial resolution. Yet, relating spatial patterns of agricultural activity, land use change and biodiversity loss to their socio-economic drivers through the global network of supply-chains is significantly hampered by the resolution of agricultural modelling in MRIO analysis. Agriculture is often modelled as a single sector nationally, with no distinction between, for example, the radically different agricultural practices employed in large-scale grazing to horticulture. At best, a disaggregation of the agriculture sector is done using basic coefficient data. The challenge, however, is common to any that involves integrating highly detailed statistics in mass units into global monetary MRIOs. Typically, constructing hybrid accounting frameworks require a series of successive steps for the imputation of missing information, transformations between units, handling multiple different product and industry classifications, and, finally, reconciling estimates with mass- and financial balances.

This paper builds on a physical MRIO mapping production, trade, and utilization of primary and processed agricultural and forestry products covering about 175 countries and 130 commodities and develops a Maximum Entropy (MaxEnt) model for its integration into a global monetary MRIO database. The MaxEnt model allows for the simultaneous estimation of unobserved commodity flows as well as corresponding prices such that possibly conflicting data constraints in various units of measurement, levels of aggregation and mismatching classifications are simultaneously satisfied.

Analyzing the CO₂ Clusters in the Global Supply Chain Network

Topic: (8.2) Methodological Aspects of Input-Output Analysis (3)

Author: Shohei TOKITO

The CO₂ emissions embedded in international trade have rapidly increased in countries with lax environmental regulations with expansion of trade and the international fragmentation of productions (Peters et al., 2011). With this background, the Paris Agreement at the 21st Conference of the Parties of the UNFCCC imposes the emission regulation on also developing countries. In addition, with the importance of the improvement of environmental efficiency at industry level of a specific country, it is important to cooperate within well-specified industrial clusters through supply chain engagement over developing and developed countries (e.g., Kagawa et al., 2015). Kagawa et al. (2015) used the World Input-Output Database (WIOD) and identified 4756 significant CO₂ clusters from global supply-chain networks associated with final demand of countries. However, they focused on only 40 countries and regions covered in the WIOD, thereby many other countries in Asia and Africa are not considered in their supply chain analysis. To the best of our knowledge, previous studies did not address the following question: how the CO₂ clusters have formed at globe over time and which supply chain partners (i.e., stakeholder countries and sectors 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, Nuss et al., 2016; Tokito et al., 2016) to the EORA database (Lenzen et al., 2012, 2013) covering 189 regions and found key sectors by applying betweenness centrality method (Freeman, 1979, Liang et al., 2016) and block modeling method (Borgatti and Everett, 1992) to the database. As a case study, we analyzed global supply chain networks associated with final demand of transport equipment sector in its higher demand countries of China, United States, Germany, Japan and France by using the Unit Structure Model (Kagawa et al., 2013). As a result, we identified 118 industry clusters and key sectors in their clusters. The results show that (1) "Mining and Quarrying (China)", "Petroleum, Chemical and Non-Metallic Mineral (China)", "Metal Products (China)", "Electricity, Gas and Water (China)" and "Mining and Quarrying (Russia)" belong to each of the larger clusters induced by final demand of transport equipment sector in the demand countries, (2) the role of the large blocks distinguished by spectral clustering are not equally, for example, although the Japanese largest cluster is mostly demand side, the U.S largest cluster trade mutually (3) Chinese industries mostly did not transfer CO₂ emission to foreign countries and constructed isolated large clusters in the global supply chains, and (4) sectors with relatively higher centrality belong to the larger clusters. Thus, it is important to take some measures in the largest emission clusters in China for reduction of CO₂ emission associated with auto demand of developed countries. Especially, technological improvement in the sectors with higher centrality is important.

Regularities in Prices of Production and the Concentration of Compositions of Capitals

Topic: (7.1) Mathematical Treatments of Input-Output Relationships

Author: Daniel TORRES

Recent developments in price of production models have proposed a hypothesis on the structure of the input coefficient matrices to explain the empirical near-linearity and monotonicity found in prices as a function of income distribution --the tendency towards zero of subdominant eigenvalues. The objective of this paper is twofold: First, based on the behavior of observed eigenvalues, the paper shows that they cannot explain by their own the regularities found in

prices of production. Second, it is shown theoretically and empirically the existence and relevance of an additional force acting on the input matrix and the labor coefficient vector: the concentration of industries' vertically integrated compositions of capital around their average. It is argued that the combined effect of these two factors produces the empirical regularities in relative prices. The tendency of the vertically integrated labor to means of production proportions to cluster around their average reveals the existence of an economic force acting on the structure of technology of observable economies and calls for an explanation. The paper relies on the US 1987-2007 Input-Output accounts, at the highest disaggregation level (between 370-466 sectors), for the empirical evidence in this paper

On the Notion of Randomness in the Study Input-Output relations and the Maximum Entropy Principle: an application to the assessment of Brody's Conjecture

Topic: (7.1) Mathematical Treatments of Input-Output Relationships

Author: Daniel TORRES

The purpose of this paper is to lay down the foundations for the study of observable Input-Output (IO) matrices from the Maximum Entropy Principle (MEP). The MEP is a statistical inference method that allows to estimate probability distributions based on partial information and at the same time be noncommittal with missing information ---it gives the least biased estimate consistent with the given information. Following this principle, we study the literature dealing with stochastic aspects of the IO models and identify their notion of randomness and the statistical and economic implications of their assumptions, i.e. their constraints. As a first exercise in the use of this principle, we will assess Brody's Conjecture, or the random matrix hypothesis on the distribution of eigenvalues, using 12 US Benchmark IO matrices for the period 1947-2007. We conclude that there is no empirical evidence to suggest that the IO matrix that would represent the statistical structure of observable matrices has 1) independent and identically distributed a_{ij} coefficients and 2) a tendency to have rank one. Our conjecture on the empirical behavior of eigenvalues is that IO matrices' column sums are constrained in their dispersion.

Understanding and Forecasting Macroeconomic Dynamics of Argentina: An Input-Output Stock-Flow Consistent model

Topic: (2.1) Special Session: Stock-flow consistent input-output modelling

Author: Sebastian Valdecantos

Co-Authors: Francisco Valentini

This paper presents an empirical model of the Argentinean economy that can be used for both explanatory and forecasting purposes. Whereas the state-of-the-art macroeconometric modelling is grounded on an instrumental approach that neglects the structural features of the economy, we propose a more realistic model that takes up the tradition of the Cowles Commission. The model aims at combining input-output analysis with the comprehensive description of the macroeconomic system embedded in stock-flow consistent models, where all stocks and flows are fully integrated into a transaction matrix that ensures no black holes in the accounting. The theoretical foundations of the model are built upon the Post Keynesian and Latin American Structuralist schools of thought. The model combines an input-output matrix with a "handmade" social accounting and flow of funds matrix. Since the institute of statistics of Argentina publishes neither a social accounting matrix nor a flow of funds matrix one of the challenges of our work is

to make an approximation to these key components of every stock-flow consistent model. Once the official input-output matrix is merged with our approximations of the social accounting and flow of funds matrices we derive a system of equations that represents the dynamic behaviour of the model. Accounting identities are directly derived from the transaction matrix. Behavioural equations are estimated econometrically using modern techniques. In order to produce short and medium term forecasts the model is specified in a quarterly basis. The structure of the model is such that several key macroeconomic and sectoral variables (GDP, inflation, current account, budget balance, sectoral output and employment, etc.) can be forecasted simultaneously in a general equilibrium framework that acknowledges the holistic nature of the economic system.

Agricultural Productivity, International Trade and Food Supply: Some Implications from a Greater Productivity in Brazil

Topic: (8.4) International Trade (3)

Author: Vinicius A. VALE

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Discussions on food production, population growth and food security have been increasingly present in the literature and in the global political agenda. Many policies in the world have taken in account these issues to confront the food insecurity; however, despite all the efforts, there still is a crisis in the global food system with thousands of hungry people around the world.

Given this context of food insecurity and some actions to radiate the hunger, it has been possible to find some discussion around the impact of international trade, increase in productivity and so on in the literature. Furthermore, Brazil has been point as an important economy in terms of food supplier.

The Brazilian economy has a high dependence on commodity exports, including agricultural one. In the previously 14 years, the Brazilian agribusiness has contributed incisively for the generation of currency for the country. Further, its exported volume grew around 230% and the trade balance around 468% from 2000 to 2013. Moreover, the Brazilian agribusiness, in recent years (2000-2011), has maintained its growth trend, with a Gross Domestic Product (GDP) increase of 3.9% per year against a GDP increase of the whole Brazilian economy around 3.6%.

Among the various factors that contribute to the Brazilian agribusiness performance, according to the Ministry of Agriculture, Livestock and Supply of Brazil (MAPA - Ministério da Agricultura, Pecuária e Abastecimento do Brasil), the existence of production, water availability, sunlight and regular rainfall in most regions of the country, agricultural policy, development and intensive use of technology, and the producer's commitment with the productivity are the major important one.

Given all the discussion about international trade, productivity, food supply and demand, and the potential of Brazil to feed the world food demand, this paper aims to analyze how an increase in agricultural productivity in Brazil affect the Brazilian economy and the rest of the World. The increase in agricultural productivity will be based on the hypothesis that Brazil reach the same productivity than USA in some of agricultural commodities. In order to analyze it, we use the Global Trade Analysis Project (GTAP) database, version 9, and consider 57 sectors and 8 regions: Brazil; China; Russia, India, South Africa, United States of America, European Union and rest of the World. Furthermore, we consider two scenarios: i) an increase in agricultural productivity in Brazil without any elimination of tariffs and export subsidies on trade; and ii) an increase in agricultural productivity in Brazil with an elimination of tariffs and export subsidies on trade with

each of the regions by Brazil (China; Russia, India, South Africa, European Union) and vice versa, excluding United States of America.

Economic interaction estimation for the construction of a regional input-output matrix from a bottom-up approach: a review of the appropriate inferential framework for regional data.

Topic: (6.5) Methodological aspects of IO analysis (2)

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The set of analytical tools used in regional economics, considers the most popular inferential framework used, that is, the parametric approach of statistical analysis. However, non-parametric approaches are part of regional economic techniques and methods and are included in specialized literature as a suitable approach to analyze regions.

As part of the methodological proposal for the construction of a regional input-output matrix from the bottom-up approach and the theoretical development of the spatial dimension of the economy, it is important to investigate the estimation of the regional economic interaction, from a non-parametric logical framework, emphasizing the spatial economic concentration as the main attribute of economic distribution through territory.

The objective of this work is to present a new proposal for the estimation of economic interaction at the regional level, from a non-parametric approach and to obtain spatial autocorrelation from a modified Moran Index, by using a weights matrix (W_{ij}) which captures economic interaction; as well as to estimate correlation by the median as a suitable reference for the regional analysis.

The research question of this work is: What type of regional economic interaction index would be required from a non-parametric perspective and how can it be applied in the construction of a regional matrix based on the bottom-up approach?. The proposal will use available data from the economic census of 2014 for the manufacturing sector of the north central functional region of Mexico, as well as the methodology proposal described in Asuad and Sánchez (2016).

This work constitutes a contribution in terms of the proposal and application from a non-parametric approach for the regional input-output methodology. It helps to strengthen regional economic analysis and recover the importance of disparities at spatial level, and economic interaction as a crucial fact of spatialized economic performance.

What are the ecosystem consequences of resource footprints?

Topic: (6.4) CGE Modelling (3)

Author: Francesca Verones

Co-Authors: Daniel Moran, Konstantin STADLER, Keiichiro Kanemoto, Richard WOOD

Knowing magnitudes of resource footprints is a useful first step for environmental impact analysis. However, these accounts alone do not inform about the consequences these pressures have on the ecosystems. In the end, consequences and not pressures alone should be guiding policy makers in environmental decisions. A method that can contribute to closing the gap between accounting of pressures and consequences on ecosystems is the newly released

LC-Impact approach, a spatially refined life cycle impact assessment method. By coupling this approach with MRIO-based pressure footprints, we calculate “ecosystem impact footprints” in terms of consequences for ecosystems. This new perspective shows that there are large differences in nation’s relative contributions to global footprints. Looking at pressure footprints shows that most wealthy countries have high footprints in lower-income countries. However, if we add the dimension of consequences, this is not necessarily true anymore, since a substantial part of the impact footprints tend to originate in other, higher-income countries. This can for example be due to the vulnerability of an ecosystem type to a certain pressure or the rarity of present species. This changed perspective might also provide a different insight on where to focus on in terms of policy actions to halt biodiversity loss.

Latin America’s route to development: A vertically integrated analysis of the Chilean case

Topic: (2.3) Structural Change and Dynamics (1)

Author: Davide Villani

Co-Authors: Gabriel Brondino

The aim of the paper is to assess the sectoral evolution of employment and productivity in Chile between 1996 and 2008. The paper discusses some of the recent contributions that took place in Latin America with respect to development strategy and sectoral specialisation. In particular, referring to recent debates that took place in the region, it asks whether resource based sectors have performed better than other sectors in terms of employment creation and productivity growth and discusses the potentialities of a development strategy dependent on natural resource based sectors.

The analysis is realised by employing vertically integrated sectors on the wave developed by Luigi Pasinetti (1973), employing Input-Output tables obtained from Make and Use tables provided by the Chilean Institute of Statistics.

The approach used can provide useful elements to address some issues of economic development that are usually underestimated from conventional approaches. By considering the economy as a circular flow, inter-sectoral relations are placed at the centre of the stage. Sectoral performance is assessed not only on the basis of its direct contribution to the economy, but also considering indirect relations, i.e. the spill-overs that the production of a net unit of final good has on the rest of the productive sectors.

The results of the vertically integrated analysis show that these productive sectors do not record a better performance in terms of employment creation and productivity growth compared to other sectors.

The Myth of Benefit of Trade: the case of Mexico's manufacturing sector

Topic: (2.1) Special Session: Stock-flow consistent input-output modelling

Author: Luis Villanueva

Co-Authors: XIAO JIANG

In many export-led development economies, such as the case of Mexico, the wages paid to the exports sectors have not necessarily increased with more demand for exports. In this context, one crucial question to answer is; if workers are not the ones benefiting from trade, where are these benefits going? We put forth a special markup pricing model in which imported intermediates play a central role to assess how the benefits of trade are distributed among four actors; workers (wages), capitalists (profits), and foreigners (imports). We use a stock-flow consistent multi-sector CGE model for the Mexican economy to empirically verify the distribution of income among these four actors. We end our paper discussing the policy implication of our findings.

Development of Japanese flexible and highly detailed multi-regional input-output modeling framework

Topic: (7.4) Special Session: Virtual Laboratories: Wrapping up Project Réunion and the Industrial Ecology Lab development

Author: Takako WAKIYAMA

Co-Authors: Furu FATURAY, Arne GESCHKE, Manfred LENZEN

Supply-chain management has become a critical issue in international politics and business as a way to identify and manage environmental, social and economic benefits and risks. In 2016, Sustainable Development Goals (SDGs) came into force where 17 sustainable development goals are set including climate change, biodiversity and sustainable consumption and production. To achieve the goal, various issues need to be considered and dealt with by covering promoting resource and energy efficiency, sustainable infrastructure, and providing access to basic services, green and decent jobs and a better quality of life for all. Thus, a systemic approach and cooperation among actors operating in the supply chain, from producer to final consumer is required. From such circumstance, the following research question comes out: how we can manage enormous dataset and analyze such cross-cutting issues with various components to manage and identify environmental, economic and social benefits and risks.

This paper describes a flexible and highly detailed economic-environmental modeling tool that allows researchers to investigate the interdependencies of different economic structures in regions and areas at detail levels to answer given research questions - the Japanese Industrial Ecology Laboratory. The framework focuses on Japan, which is the world's second largest developed economy. The Japanese IELab is a collaborative virtual laboratory in which Japanese multi-regional input output databases can be created that will cover economic activities from national to city level in Japan. It will feature a highly flexible and spatial structure and function to facilitate the capability of an integrated analysis of life cycle assessment, carbon footprint, water footprint, ecological footprint and other approaches to environmental impact assessment.

As the methodology and data used for this paper, the development of the Japanese IELab will be achieved by integrating different source data, such as data of multi-regional input output (MRIO) tables, trade statistics, environmental statistics, and household expenditure statistics, into a

harmonized data processing framework. The Japanese IELab will use the data processing engine developed for the Australian IELab in order to harness the abundance of information provided by different source data sets. The source data sets will contain information of the following type: regional level data including income, production and employment data, sub-sectors of energy, material, water, transportation, industry, and agriculture and forestry, and inter-regional trade across different prefectures and cities. The novelty of this research is that, following the integration of all these source data sets, the Japanese IELab will be the most comprehensive and detailed data set for economic activities in Japan.

Supply Chains and Tariff Rates: The Impact of Reversing NAFTA

Topic: (2.4) CGE Modelling and Trade Agreements

Author: Terrie Walmsley

Global trade models are widely used to examine the impact of trade agreements on the global economy. The data upon which these models are based, however, are very aggregated, not only with regards to the level of commodity detail, 57 sectors, but also the distinction between trade in intermediate and final goods. This distinction between trade in intermediates and final goods has become increasingly relevant in policy analysis as trade in intermediates has grown rapidly world-wide, and supply chains have become longer and increasingly global. This paper introduces a new model and database, the ImpactECON global supply chain (IESC) model and database, based on the GTAP Model, that takes account of differences in the sourcing of imports firms, final consumers and for investment; as well as the differential tariff rates on these goods. The differences in sourcing of imports by end-use allows the IESC model to capture the existence of supply chains, for instance the high vertical integration of trade and production within the NAFTA region. The differences in tariffs by end-use stem from the fact that a motor vehicle (category MVH in the GTAP database) sold to a final consumer differs from the motor vehicle (part) sold to firms and to the motor vehicle (a crane) sold for investment purposes; and as such these different commodities are likely to be subject to different tariff rates. This is believed to be the first multi region input-output database that takes account of differences in tariff rates across uses and is publicly available.

Using this model and database, this paper seeks to demonstrate how the integration of supply chains and differential tariffs can improve analysis of trade policy. To illustrate this, we examine the North-American Free Trade area, where trade in intermediates has grown exponentially since the signing of the North-American Free Trade Agreement (NAFTA) over 20 years ago. With public perception of trade agreements at an all-time low, we examine the impact of a potential rise in US tariffs on imports of goods from Canada and Mexico to most favored nation (MFN) rates. We also consider the potential impact of Canada and Mexico retaliating to the new US trade policy stance, by also raising their own tariffs on US goods to MFN rates. Overall, the results show that the US's reversal of NAFTA leads to a decline in real GDP, trade and investment in the US, Mexico and Canada, with the potential for much greater larger loses should Mexico and Canada chose to retaliate. 250,000 workers in the US become unemployed, if Mexico and Canada retaliate. Sectoral production rises or falls depending on the inter-related nature of trade in intermediate and final goods and the extent to which tariffs rise on each of these goods. The largest declines for the US from its reversal of NAFTA occur in manufactured goods - those sectors which prompted the call for more protectionist policies. There is some potential for growth in production of cranes, semi-trailers and tractors (motor vehicles purchased for investment), as domestic production replaces Mexican imports of these goods when the US raises tariffs; however, these gains are reversed if Canada and Mexico retaliate. The impact of Canada and

Mexico's retaliation is positive in general for US manufacturing (other than motor vehicles).

When comparing our results with the standard GTAP model, we find that while the macroeconomic results of the two models are similar, the sectoral results differ markedly when NAFTA trade and production are interrelated, as is the case in the motor vehicles sector. The benefit of including supply chains is most clearly evident when investigating the impact of tariffs by end-use, for instance the introduction of a policy aimed at raising tariffs on imports of consumer goods (as opposed to intermediate inputs), since only the supply chain model can capture the inter-related nature of trade and production and differential tariff rates applied on imports of intermediate versus final goods.

A sub-national multi-regional input-output laboratory for policy making in China

Topic: (7.4) Special Session: Virtual Laboratories: Wrapping up Project Réunion and the Industrial Ecology Lab development

Author: Yafei WANG

Significantly unbalanced development and heterogeneity across Chinese regions has been identified and acknowledged in various researches using Chinese multi-regional 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-regional 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.

Allocating Carbon Responsibilities in the Global Value Chains: A value-added Capturer Responsibility Principle

Topic: (10.4) Environmental IO modeling and CO2 Emission

Author: Rui WEI

Co-Authors: Wencheng ZHANG

Abstract: With the development of global value chains, the 'polluter-pays principle' does not consider the economic benefit structure of production when allocating national carbon emissions responsibilities. All carbon emissions in the value chains of a product serve its end of value creation. However, the distribution structure of economic benefit can be significantly different from that of carbon emissions. A country might capture most part of value-added created in the production of the product in the global value chain of a specific product (e.g., a laptop), whereas it might bear little environmental burdens even it has relatively more resource to deal with them. In the present study, we propose 'value-added capturer responsibility (VACR) principle' to allocate emissions responsibilities from production. Suppose one type of laptop is produced by several countries and its final price is P . And suppose further the production of one such laptop induces E units of carbon emissions globally and firms in country A obtain V units of value-added

from participating the production networks of the laptop, then the emissions responsibilities of country A would be $E^*(V/P)$ based on VACR principle. V/P is the share of value-added captured by firms in country A which equals the responsibility share in the VACR principle. Based on the World Input-Output Database, we reallocate national carbon emissions inventories of 40 countries and regions based on VACR principle. We first calculate total carbon emissions of each final product (i.e., carbon footprints) and value-added captured by each country, then we reallocate national responsibilities based on value-added shares. The national emissions inventory of each country is obtained by totaling up the emissions responsibilities from every final product. We compare the new inventories with inventories based on 'polluter-pays principle', that is, the 'territorial principle', and 'consumer-responsibility principle' which allocates emissions responsibilities to final consumers. The results show that cumulative emissions responsibilities (1995-2009) of the USA, the EU and Japan based on VACR principle are 7.6%, 24.4% and 30.9% respectively greater than their responsibilities based on 'polluter-pays principle', whereas the new inventories of China, Russia and India are 19.2%, 28.7% and 12.8% respectively lower than their traditional inventories. We have discussed the possible advantages and disadvantages of VACR principle from various respects compared with the 'polluter-pays principle' and the 'consumer-responsibility principle'. We don't suggest replace 'polluter-pays principle' with VACR principle. But like assessment based on 'consumer-responsibility principle', the inventory based VACR principle can be a useful complementary indicator to inventory based on 'polluter-pays principle' in guiding efficiency carbon mitigation and promoting international cooperation of climate policy.

Identifying emission hotspots for technology transfers using an extended version of the inverse important coefficient methodology

Topic: (3.7) Techniques for Identifying Important I-O Coefficients and Sectors

Author: Kirsten S. WIEBE

Analyses using global multi-regional input-output models such as EORA1, EXIOBASE2, the OECD ICIO3 or WIOD4 show that there is a significant global imbalance of where in the world final demand for products occur, where these products and their intermediate inputs are produced and where most of the pollution along global production chain occurs.

This global imbalance of consumption, production and CO₂ emissions could be substantially reduced by employing state-of-the-art low-carbon technologies around the globe^{5,6}. This, however, needs to be initiated. Data on consumption-based or – a slightly different concept – final-product-based CO₂ emissions raise the awareness of the link between final goods and the environmental pollution caused by upstream production processes. Consumption-based emissions allocate the emissions to those countries where the final product is consumed, while final-product-based emissions allocates the emissions to the country and industry where the final product is produced. With this data, consumers and producers of final products learn where in the world CO₂ was emitted along the upstream production chain.

Using multi-regional supply-and-use tables from EXIOBASE and extending the inverse important coefficient methodology⁷ by emission factors enables us to identify "emission hotspots", i.e. countries/industries where a bulk of the upstream emissions of final products occur. The interaction of input coefficients with CO₂ intensity coefficients adds a term to the original optimization problem that finds the inverse important coefficients. This new methodology enables us to identify for which industries in which countries changes in emission-relevant inputs have the largest impact on final-product based emissions. This knowledge can be used for well targeted technology transfers from CO₂-consuming to CO₂-emitting countries. If industries care about the CO₂ footprints of their final products, these technology transfers can provide a cost-effective way

of reducing their footprint. The research at hand presents this analysis using, as an example, Germany's consumption of final products and final products produced by Germany's automobile industry. The analysis suggests that technology transfers to both industrialized and developing countries in different industries, mainly energy intensive industries, could imply a significant reduction in CO₂ emitted in upstream production processes.

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Material Requirements and Emission Footprints of Low-carbon Technology Diffusion - Combining a Dynamic MRIO Approach with Elements from System Dynamics Modelling

Topic: (9.2) Dynamic IO Modeling and Analyses of Capital Formation

Author: Kirsten S. WIEBE

To reduce the increase of global temperatures to maximal 1.5 degrees, countries need to start acting as soon as possible. There is no time to wait for a new break-through technology; rather existing low-carbon technologies (LCTs) should diffuse as quickly as possible. Using input-output analysis, we show the direct and indirect environmental effects of the transition to a low-carbon development path considering not only the environmentally friendly use-phase of the LCTs, but also the environmental effects of building the technology stock.

We first develop a dynamic version of multi-regional supply-and-use table (SUT) system of EXIOBASE [1] up to the year 2050. In a second step, we explicitly model the transition to LCTs (using the example of the electricity industry) and their effect on the structure of the global economy. Different parts of the global SUT system that are adapted as suggested in [2]: final and intermediate demand for the different types of electricity, the input structure of those industries producing the new technologies and final demand for gross capital formation.

The capital stocks and flows of LCTs as well as the main materials required by these are modelled using elements from the system dynamics approach (as used for example in the WORLD3 model in [3]). To this end, the current technology stock, its size, age and expected life span, as well as the technology stock required to achieve the emission reductions is considered. Net operating surplus from the MRIO model and natural resource stocks and related rates of exploitation of those set limits on technology production possibilities.

The results show that the transition has different impacts on different environmental stressors, but that the environmental pressure will significantly decrease in the long-run with a transition to a low-carbon development pathway.

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Expanding a Global MRIO for City Footprint Analysis

Topic: (8.6) Special Session: Consumption-based accounts for global cities: data, methods and analysis

Author: Thomas O. WIEDMANN

Co-Authors: Manfred LENZEN, Anne OWEN, Guangwu CHEN, Johannes TÖBBEN, Yafei WANG, Futu FATURAY, Harry C. WILTING

Most consumption in modern economies takes place in cities. As a consequence, consumption-based accounting of resource use and emissions often allocates a large proportion of total national environmental footprints to urban final demand. City governments and authorities are therefore increasingly interested in analysing and quantifying these indirect environmental impacts of their jurisdiction and standards for consumption-based greenhouse gas accounting in cities are being developing and refined.

However, calculating the carbon footprint of cities with input-output analysis – as commonly done for nations and regions – is often hampered by the lack of city-specific input-output tables and satellite accounts. In this contribution, we present an approach for estimating two-region input-output tables for any city and the rest of its nation. We then nest these tables in a global multi-region input-output model based on the GTAP database and calculate global carbon footprints of city final demand. Particular emphasis is placed on the uncertainty of the suggested method which is based on a modified simple location quotient and rebalancing approach. We compare the derived two-region tables with input-output tables based on actual surveys (Beijing and Shanghai) and with those derived from different approaches to regionalisation (Nanjing, Guangzhou, Wuhan, Chengdu, Berlin, Jakarta, Sydney and Melbourne). We analyse the differences in tables and in carbon footprint results, allowing us to refine and optimise the settings and assumptions in the regionalisation approach applied in this study.

The Emissions Trading Scheme Design under the Renewable Energy Sources Policy in China

Topic: (9.6) Environmental IO Modelling (6)

Author: Jie Wu

In the Intended Nationally Determined Contribution (INDC) submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in June 2015, the Chinese Government announced its intention to cut CO₂ emissions by 60%–65% per unit of GDP by 2030 compared to 2005 levels, and for 20% of total energy consumption to be derived from non-fossil sources by 2030. To achieve both the emissions reduction targets and renewable energy promotion target, the emissions trading scheme (ETS) and renewable energy sources (RES) policies have been considered two essential market-based instruments in China. While the RES policy was adopted since 2016, the ETS in China is in the form of seven pilots in the present. A nationwide carbon market is going to be implemented in 2017, which aims to reduce CO₂ emissions effectively. Since the main power generation remains the coal-powered generation in China, the ETS policy

will bring higher costs for fossil-derived generation and thus lead to the substitution of renewable energy for fossil energy. At the same time, the RES policy is targeted to increase the renewable energy usage, which overlaps with the ETS policy. Therefore, the combination of ETS and RES policies raises an important issue: What is the effect of the co-existed ETS and RES policies on energy structure and regional economies in China? How to design the nationwide carbon market effectively considering the RES policy in China? This study answers these questions using a multi-regional computable general equilibrium (CGE) model in China, which is able to capture the economy-wide impacts. Focusing on the design of the nationwide carbon market, this paper analyses the economic impacts of ETS in combination with RES policies in China.

Six policy scenarios are set for the implementation of ETS and RES policies in the paper: a nationwide carbon market alone; and five scenarios for the combination of ETS and RES policies with a FIT subsidy ranging from 20% to 100%. The results show that the CO₂ price in the nationwide carbon market would decrease by 11%–64% with increasing renewable energy subsidies, thereby is disincentive to low-carbon investment. At the same time, the total trading volume of ETS is predicted to decrease by 3%–25%. Secondly, combining a FIT with an ETS imposes additional GDP cost and welfare loss in all regions, thereby increasing the cost of the policy by 0.01%–0.06%. Eastern regions, which have higher abatement costs and lower potential for developing renewable energy, face more significant social costs under the combined ETS and RES policies than with ETS alone. Lastly, the electricity industry faces a decline in total output; however, it experiences less reduction of CO₂ emissions and decline in CO₂ intensity under the combination of ETS and RES policies than with ETS alone. In conclusion, as the implementation of the nationwide carbon market is imminent, policymakers should not ignore the economic impacts of the overlap between ETS and RES policies in China.

Trade performance in domestic value chains with emissions perspective

Topic: (1.3) MRIO Modelling

Author: Yan XIA

Co-Authors: Min Wei

China's flourishing economic growth, increasing energy consumption and carbon emission has been extraordinary regional differentiation problem for structure of a nation's economy, physical geography, resource endowments, and other factors. The fragmentation of production across national and regional boundaries is a defining feature of the modern interregional economy. This calls for new measures to analyse trade patterns and embodied CO₂ emissions in trade. As the McKerlie et al. (2006) suggest that all parties with a role in designing, selling or using a product are responsible for minimizing the environmental impact of the product over its life. A significant amount of emissions originates and flows between regions in the goods that are traded between provinces, the embodied emissions in trade. Embodied emissions is a kind of concept used to examine the extent to which emissions are embodied in the interregional trade of goods and services (Wiedmann, 2008). If a country has to import a large amount of intermediate inputs to assemble its export products, the value added is much less than the gross exports value. In the end, it is the domestic emissions content in trade. In a hypothetical case, If cars are produced in two regions Guangdong and Shanghai. Guangdong sells cars to consumers in itself and in Yunnan. Shanghai's car industry sells on its domestic market and to export. Steel was produced in Yunnan then the emissions that went into producing that steel is typically attributed Yunnan. Perhaps a better way of accounting for the emissions is to attribute it to the province in which the car itself is consumed, at the source of demand, rather than that of supply. Therefore, how to

estimate the embodied emissions in interregional trade is vertical to measure the domestic value chains and trade patterns.

In this paper, we outline two perspectives on the CO₂ emissions content of interregional trade. We distinguish two perspectives: the bilateral trade perspective (BT) or direct trade flow (DTF) perspective, and the multi-lateral trade perspective (MT) or global value chain (GVC) perspective. We found that the BT perspective is useful to analyse the domestic embodied emissions content of exports or outflows. The MT perspective is useful for tracing the carbon footprints and the development of global value chains.

In conclusion, first, there are three key trading blocks. The Central Region is the main embodied emissions exporter, with significant flows to the East and North Coasts, while the Southwest Region is the main supplier of embodied emissions to the South Coast provinces. A smaller trading block exists in the north between the interior Northwest Region and the Northern Municipalities and Northeast. These distinct groupings reflect the regional characterization of internal trade within China, due to the limited transport infrastructure linking the country, combined with the distances involved. Second, the bilateral perspectives require a split of the exports by region of destination but still do not require a multi-regional input-output table. To analyze the new trade patterns, we decompose emissions into tree components, a multi-regional input-output table is needed and some double-accounting pitfalls should be avoided.

OECD Inter-Country Input-Output Database 2016 edition: A Firm Heterogeneity Extended and National Accounts benchmarked approach

Topic: (10.2) Special Session: The Current State & Future plans of Global MRIO databases (2)

Author: Norihiko YAMANO

The procedure for compiling the Inter-Country Input-Output (ICIO) database starts with filling data gaps and harmonizing the national data sources (National Accounts, supply-use and input-output databases). Trade flows are then balanced in different stages. The ICIO is finally converted from the inter-country use at purchasers' prices and national supply tables. In addition to the methodological contributions to filling gaps of data sources and balancing procedure, other notable features of the OECD ICIO system developed are summarized as 1) wide coverage of global economy (63 countries/economies), 2) benchmarked to official annual National Accounts statistics (SNA1993), 3) explicit split between cross-border trade and direct purchases by non-residents abroad and 4) firm heterogeneity extensions for processing trade sectors in China, PR and Mexico.

Where to Buy Your Imports and the Potential for Reducing CO₂ Emissions

Topic: (10.4) Environmental IO modeling and CO₂ Emission

Author: Bingqian YAN

Co-Authors: Erik DIETZENBACHER, Bart LOS

Despite the attention consumer responsibility for emissions has received in the literature, only a few studies analyze the emissions reduction potential of consumption-based environmental regulations. To fill part of this gap, this study combines linear programming models with input-output analysis to find the global CO₂ emissions minimizing reallocation of imports of final products across exporter countries. The structures of global supply chains (i.e. the sourcing

patterns of intermediate inputs) are assumed to remain unchanged, since these cannot be affected directly by consumers. Our model allows the world to reduce emissions by deploying differences between country- and industry-specific production technologies (including emission intensities), under constraints that maintain the current scales of economic activity in each of the countries. The optimal solution determines who imports from whom on the basis of comparative advantage regarding emission characteristics of the production processes of final products. The emission data and data on the structures of global supply chains are taken from the World Input-Output Database (WIOD).

Our results show that the emissions reduction potential was about 1Gt (3.8% of the global CO₂ emissions) in the year 2007. The optimal solution yields the largest emission reductions in China, India and the USA. Reallocation of imports of final products would reduce global emissions in particular in industries like Electricity, Gas and Water Supply, and Chemicals and Chemical Products. Considering that the optimal reallocation would require massive structural changes all over the world and the reduction potential is still relatively small, we conclude that such consumption-based environmental policies by reallocation are not effective in emissions reduction.

The Path of Chinese Regional Emission Reduction Target in 2030 - A Research Based on network-DEA and input-output technique

Topic: (3.6) Environmental IO modeling (3)

Author: Ye Yao

At present, China enhance its actions on climate change, which included the intention to low the carbon dioxide emissions per unit of GDP by 60-65% from the 2005 level. However, the diversities and differences are not only exist in the regional energy conservation foundation and economic development, but also exist in the sectoral energy efficiency and energy saving potential. Even to complete the same carbon reduction rate, the corresponding technical efficiency are also dramatically different. In addition, the differentiation of CO₂ emission reduction target allocation in different regions and sectors, which will directly have influence on the regional industrial structure adjustment and the strategy of different energy production and consumption. In order to complete the CO₂ emissions targets in 2030, China should consider maximizing the overall allocation efficiency of all regions and sectors. Therefore, this paper innovational uses the Network ZSG-DEA method in combination with Chinese inter-regional input-output table in 2007 to build the scientific distribution mechanism of binding CO₂ emission reduction target and to embody the difference in economic development, industrial structure and emission reduction potential among whole regions and sectors. Results show that: each region and sector will have different emission reduction path in the allocation of 2030 national carbon emissions reduction targets. Furthermore, several energy-intensive industries' reduction target will exceed national average standard, such as Mining Industry, Non-Metal Mineral Product Industry etc., which means those need to make more efforts to shift towards a low carbon development.

Efficient Operations of Industrial Symbiosis: An Enterprise Input-Output Model Integrated by Agent-Based Simulation

Topic: (3.1) Methodological Aspects of IO Analysis (1)

Author: Devrim Murat YAZAN

Co-Authors: Luca Fraccascia

Industrial symbiosis (IS) is a key for the implementation of circular economy. Through IS, wastes produced by one company can be used as primary inputs by other companies. Although identification of IS opportunities is usually enhanced, planning and operational phases still suffer from high uncertainty barriers as wastes are not produced upon demand but emerge as secondary outputs, depending on the demand for main outputs produced. The amount of a generic waste that two companies can exchange depends on: i) technical waste production coefficient of waste-producer; ii) primary input requirement coefficient of waste-receiver; and iii) final demands for main outputs produced by companies. However, these factors can change over time, causing uncertainty on potential physical flows. Such an uncertainty triggers fluctuations in waste treatment and transportation costs and makes difficult assessing the future economic benefits, thereby hampering companies to establish symbiotic collaborations. Companies need to deal with this operational uncertainty. In particular, they need dynamic models providing sensitivity analysis on factors affecting potential economic benefits.

This paper adopts an enterprise input-output model and integrates it into an agent-based model to measure the impacts of above-mentioned factors on economic benefits of IS. Empirical context covers a circular economy business case based on agriculture, animal farming, and biogas production.

Findings show that the quantitative ratios between final demands and waste and primary input coefficients are critical to optimize the cooperation. Some cases demonstrate that less technical efficiency or more waste production may increase the economic benefits, while others show that dematerialization or final demand change may reduce IS costs. Accordingly, information-sharing about adopted technologies and market demand help efficiently operationalize IS and highly encouraged by authors. Results lead us to innovative ideas to facilitate cooperation between separate sectors and implement future production zones nearby the waste streams rather than primary input locations

Keywords: industrial symbiosis, enterprise input-output, cooperation, operations, agent-based simulation

Cooperation Decisions in Industrial Symbiotic Relations

Topic: (5.4) Industrial Ecology using IO Tables

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As a cooperative industrial practice, Industrial Symbiosis (IS) is expected to play a major role in implementing circular economy. Firms involved in Industrial Symbiotic Relations (ISRs), i.e., emerging relations for waste exchanges among production processes of originally distinct firms, can enjoy mutual environmental and economic benefits. Moreover, ISRs have a positive influence on both the resilience of firms and the efficiency in exploiting available resources.

Although IS takes place between two production processes of two firms, it makes indirect and induced impacts on the physical and monetary flows through their traditional supply chains triggered by resource use change. Hence, firms need analytical tools tailored to support their

decisions whether to cooperate in, and operationalize a particular ISR proposal measuring such impacts. Therefore, such a decision support tool has to regard multiple operational aspects such as presence of competitors and regulations and should be able to dynamically visualize the consequences of taken decisions through entire supply chain. Although methods for analyzing each of these dimensions separately exist, analyzing the cooperation decisions in ISRs calls for joint methods that are able to take into account multiple aspects.

For this account, we apply Enterprise Input-Output (EIO) analysis for modeling the physical flows of resources and exploit game-theoretic schemes for reasoning about cooperation decisions. Hence, according to the cooperation strategies adopted by companies in the game theoretic approach, upstream and downstream supply chain flows are dynamically updated and visualized on input-output tables. Moreover, we study the macro-behavior of ISRs regarding the cooperation decisions by using Multi-Agent-Based Simulations. Our empirical context is based on a circular business case from processing industry.

Our study provides practical insights for firm managers facing the cooperation decisions in possible ISRs. Furthermore, a methodological advance in studying IS is provided by bridging mature fields of input-output analysis and game theory.

Keywords: Industrial Symbiosis; Decision-making; Enterprise Input-Output Analysis; Game Theory; Multi-Agent-Based Simulation.

Assessing the Effectiveness of Aid to Disaster-Prone Households using Local Economy-Wide Impact Evaluation Approach

Topic: (5.1) Special Session: Disaster Impact Analysis

Author: Krista Danielle Sy Yu

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Natural disasters have negative consequences to both industries and households. Industries suffer from disruptions in their production activities while households experience problems such as damages to their houses and other assets. In the case of households, this would require them to spend unexpected amounts that would deplete their resources. In developing economies, this is more evident for households as a larger share of the population may suffer from such, however, the need to conduct the necessary repairs is of urgent concern. This study considers a local economy wide impact evaluation (LEWIE) approach to evaluate the effectiveness of government aid to disaster-prone households in alleviating poverty. LEWIE is a village level general equilibrium model which measures the transmission of impacts across the economy to include spillover effects of the aid payment to both treated and non-treated households. However, the amount of the aid and the behavior of households, may vary and yield different results. Sensitivity analysis on the amount of the aid to be given, and elasticity of substitution between factors of production using the latin hypercube design of experiments to observe the impact of introducing such measures into the economy that will maximize the impact of aid given. A village economy from Taylor (2012) will be used to illustrate the method introduced in this study.

Implementing Hybrid LCA Routines in the Industrial Ecology Virtual Laboratory

Topic: (7.4) Special Session: Virtual Laboratories: Wrapping up Project Réunion and the Industrial Ecology Lab development

Author: Man Yu

Co-Authors: Thomas O. WIEDMANN

Hybrid life cycle assessment (LCA) – combining conventional process-based LCA and environmentally-extended input-output analysis (EEIOA) in a variety of ways – has been developed for almost 40 years. The most sophisticated form of hybridization is integrated hybrid LCA as it applies a consistent mathematical framework that combines complete sets of process and IO data. However, compiling the cut-off matrices that connect the two datasets is laborious and subject to limitations based on data availability and assumptions taken, impeding a wider uptake of hybrid LCA. This study intends to alleviate these limitations by automating hybrid LCA integration in the Industrial Ecology Virtual Laboratory (IElab), a cloud-computing research platform.

IElab compiles multi-region input-output data in the form of supply and use matrices, extended with several environmental accounts. It provides the most comprehensive breakdown of the Australian economy at a level of 2214 spatial areas and 1284 economic sectors, which has enabled various detailed environmental impact analyses. Since the automation of fully integrated hybrid LCA has not been attempted on this platform before, the core and novelty of this study is the automated procedure that links the full datasets from Ecoinvent and AusLCI process inventories to IO data. This is achieved by writing and applying an algorithm that fills in missing information in the upstream and downstream matrices of the integrated hybrid table.

Once the automation has been completed, it will be used to assess the life cycle environmental impacts of the construction sector in Australia. Construction plays a dominant role in contributing to greenhouse gas emissions and material consumption in Australia, manifesting far-reaching implications on energy use, natural resources depletion and waste generation. The results will be compared with the results obtained by other pure and hybrid LCA methods, and an uncertainty analysis based on Monte-Carlo simulation will be presented.

Measures of Participation in Global Value Chains and Recent Global Business Cycle

Topic: (8.8) Global Value Chain and Vertical Specialization (2)

Author: Xinding YU

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This paper makes two methodological contributions. First, it proposes a framework to decompose total production activities at the country, sector, or country-sector level, to different types depending on whether they are for domestic demand, traditional international trade, simple GVC activities, and complex GVC activities. Second, it proposes a pair of GVC participation indices that improves upon the measures in the existing literature. We apply this decomposition framework to a Global Input-Output Database (WIOD) that cover 44 countries and 56 industries from 2000-2014 to uncover evolving composition patterns of different production activities. We also show that among all production activities, complex GVC activities co-move with global GDP growth more strongly than other types of production activities.

The Measurement of China's national and provincial employment Inducing Effect-Based on China's non-competitive national and provincial IOTs in 2012

Topic:

Author: Jianqin YUAN

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Under the background of slowing economic growth, the structural unemployment in China will become a particular challenge in the process of economic restructuring and industrial upgrading. Therefore, how to enhance the ability to absorb employment has become an urgent problem to be solved. From the perspective of national and provincial level, based on China's national input output table and employment statistics in 2012, we firstly compiled an employment matrix at 42-sector and 5-category of labor level, then measured the employment inducing effect of different types of labor and comparing with the results in 2007 which we estimated previously; thirdly, we calculate the average employment elasticity of 2007-2012 between different types of labor and industries based on 2012 Constant price input-output table to analyzes the absorption ability for different types of labor employment. On the other hand, based on provincial input-output tables, we developed the employment matrix of 31 provinces in 42 sectors and 4 types of labor, and measured employment inducing effect of 31 provinces so as to provide data support for the implementation of employment promotion policy in China, and put forward relevant policy recommendations.

Measuring the Domestic Value Added Chain based on 2012 China Multi-Regional input-output table

Topic:

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In China, the inflow and Outflow for most provinces, instead of export and import, are becoming the main trade form in recent years, so the domestic value added chain plays more important role in provincial economic development and industrial upgrading. In this paper, we study and improve the methodology and procedures on how to build China's multi-regional input-output (CMRIO) model from previous ones, and develop the 2012 model. Then, based on 2012 CMRIO, we measure the distribution of trade value added among provinces, the degree and position of participating domestic value added chain and try to analysis the domestic production network thus to distinguish the different pattern of participating domestic value added chain of each province. Finally, according to above results, some recommendations will be put forward to promote economic restructuring and industrial upgrading of each province.

Identification of productive chains in the subregions inside of Chiapas using the input output regional matrix under the bottom-up approach.

Topic: (4.7) Region/country-specific analysis (1)

Author: Krista Zafra

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Identification of productive chains in the subregions inside of Chiapas using the input output regional matrix under the bottom-up approach.

Author: Krista Zafra

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Inequality in the development of states, cities and regions in Mexico shows that economy does not function homogeneously, there are differences in the relief, climate, water and vegetation resources that largely determine an economic functioning differentiated by regions. This differentiated performance allows us to observe that the aggregate economic analysis is insufficient to capture the peculiarities of the economic development in each region and therefore to identify their needs and potentialities.

In this sense, the present document intends to provide an analysis of a regional approach based on the creation of multisubregional product input output matrices that allow the identification of the productive chains existing in the state of Chiapas, because this state is one of the most economic and socially lagging, compared with the national performance and other states. Because of this the question this paper try to answer is: what are the productive chains existing in the state of Chiapas, that can support regional development?

Using the bottom-up methodology for the construction of input output matrixes presented by Asuad and Sánchez (2016), multisubregional matrices will be constructed within the state of Chiapas based on the economic census data for 2014 as well as the necessary information from official sources of the entity, likewise, productive linkages and their distribution will be identified.

The novelty of this research is that using the bottom-up approach for the construction of multisubregional input matrixes and the identification of productive linkages can capture the reality of the economic performance of the subregions, and use this approach in order to achieve an application to enhance the economic and social development of the entity in near future.

The Effects of Technology and Division of Labor on Value Added Rates: an Analysis Based on Input-Output Model

Topic: (3.7) Techniques for Identifying Important I-O Coefficients and Sectors

Author: Hongxia ZHANG

Abstract: The value added rates of variant industries in many countries keep decreasing in recent years. This paper investigates this issue, and discusses how technology progress and the development of division of labor affect the value added rates. First, a framework for analyzing value added rates based on input-output price model is built, and used to investigate the

relations between the two factors and value added rates theoretically. Then by using world input-output tables in current and previous year prices, the effects of technology and division of labor are analyzed empirically. The main results are as follows. Firstly, technology progress alone will lead to the increase in value added rates. Secondly, for division of labor, the results are complicated. The division of labor without technology progress and efficiency improvement will certainly cause decreased in value added rates. However, division of labor accompanying technology advance and efficiency increases has different effects: for the industry where division of labor originates, its value added rate does not necessarily decrease, and may increase in some occasions; for other industries, their value added rates will increase. The empirical results show that from 1996 to 2007, international specializations with efficiency improvements lead to increases in some countries' manufacture value added rates, such as US Japan, India and European Union. But for China, the manufacture value added rate actually decrease under international specialization. The main factor causing the decreases of value added rates in US and Japan is price changes, and the main factors for the decreases of value added rates in EU and Canada are non price factors except for international division of labor and price changes.

Key words: value added rate; division of labor; technology; input-output price model

An analysis of the regional economic effects of carbon tax in China: based on the production-based and consumption-based emissions

Topic: (7.3) Regional input-output modeling (1)

Author: Kun Zhang

Co-Authors: Qiao-Mei Liang

Abstract: As one of the most cost-effective means of reducing emissions, carbon tax has long been supported by most economists and scholars. Based on the 2007 multi-regional input-output table, this paper discusses the impact of carbon tax on the China's eight regional economy and the short-term competitiveness of industrial sectors from the two accounting principles of production-based emissions and consumption-based emissions. Meanwhile, in order to maintain the principle of tax neutrality, carbon tax revenues are used to reduce the production tax and a lump-sum transfer to household, respectively. We found that, if the carbon tax revenues are used to reduce the production tax, the economically developed regions such as Beijing-Tianjin, Eastern Coastal and the Southern Coastal are the net beneficiaries of the carbon tax policy, while the Central, Northwest and Southwest the more economically backward areas are need to bear the additional carbon tax burden. However, if the carbon tax revenues are used as a lump-sum transfer to household, this result is just the opposite. Moreover, under different emissions accounting principles, the impact of carbon tax on sectors competitiveness are quite different in various regions. Specifically, the potential effects of carbon tax on each sector in Beijing-Tianjin, Northern Coastal, Eastern Coastal and Southern Coastal are greater under the consumption-based principle than under the production-based principles. In contrast, the sectors in Northeast, Central, Northwest and Southwest are more influenced by carbon tax under the production-based emissions than under the consumption-based emissions. Therefore, in formulating the carbon tax policy, how to define the carbon emission responsibilities of each region and how to use the tax revenues will have a great impact on the implementation effect of the policy. At the same time, policy-makers should also pay attention to the impact of carbon tax on the balanced development of regional economy while achieving carbon emission reduction.

Keywords: Carbon emissions; Accounting principles; Multi-regional input-output analysis; China

The oil-slick trade: An analysis on embodied crude oil in China's trade and consumption during 1995-2011

Topic: (6.3) Energy Input-Output Modeling (2)

Author: Wencheng ZHANG

Co-Authors: Rui WEI

China has become the world's second largest crude oil importer and consumer. Meanwhile, China has also become the world workshop and the world's largest exporter of commodities. Many studies have discussed the direct trade flows of crude oil in China and paid special attentions to the increasing crude oil imports of China. However, the globalization of production and consumption has important impact on China's oil consumption, which can't be adequately assessed only through checking China's direct imports and exports of crude oil. Based on a global multi-regional input-output model and the World Input-Output Database (WIOD), this article examining both China's direct trade of crude oil and embodied crude oil in China's exports and imports of goods and services during 1995-2011. The results showed that about one fifth to one third of imported oil is used to producing exports in China. Therefore, China is playing the role as a transit hub of crude oil from extraction places to global final consumers, particularly those in advanced countries. Foreign consumers actually benefit from China's global hunt for natural resources, a fact usually overlooked by critics of China's oil thirst. China was net exporter of embodied oil. Net exports of embodied oil increased after China's entry into the World Trade Organization in 2001, but decreased quickly after the financial crisis starting in 2008 due to weak foreign demand and aggressive economic stimulus in China. In addition, China's oil demand from production was greater than that from consumption, whereas the gap has shrunk quickly in recent years. We also found that China's oil import dependence assessed from consumption end was higher than import dependence assessed from production end, a traditional indicator often discussed in the context of energy security. We discussed various policy implications of these results in context of China's recent reforms in economic and environmental governance.

The Methodology and Compilation of 2012 China Multi-regional Input-output Model

Topic:

Author: Yaxiong ZHANG

Co-Authors: Jifeng Li, Jianqin YUAN

In this paper, we study and improve the methodology and procedures on how to build China's multi-regional input-output (CMRIO) model from previous ones, and develop the 2012 model. The structure and characteristics of the inter-regional IO model make it difficult to develop simply based on statistical and survey data, thus the scientific estimation methodology of the data is also important. In CMRIO model compilation work, we adopt the survey and non-survey methods and use the inter-provincial trade data from the national IO survey conducted by National Bureau of Statistics and various transportation data. The compilation also relies on each province's IO table, using the national table as the control totals. The big different of the methodology and procedures from previous CMRIO compilation is that we first conduct the consistency check between the national and provincial tables thus improve the provincial ones, and then we try to modify some control total policy to reduce the discrepancy.

Technology-Adjusted National Carbon Accounting for Greener Trade Pattern

Topic: (8.3) Environmental IO Modelling (5)

Author: Zengkai Zhang

A large proportion of global emissions is induced by international trade, and an effective carbon accounting system should encourage trade patterns that generate global carbon savings. Neither production-based accounting (PBA) nor consumption-based accounting (CBA) schemes satisfy this condition and Kander et al. proposed the technology-adjusted consumption-based accounting (TCBA) method based on a Leontief demand-pull model. However, the original Leontief insight is not sufficient to quantify the emissions induced by export flows at bilateral and sectoral level. This paper proposes a more generalized technology-adjusted carbon accounting scheme that takes into account technology difference in bilateral exports of different products. Based on WIOD, this study calculated national carbon emission under four different accounting schemes. Given the consideration that TCBA faces the problem that regional carbon responsibility is negative, this paper recommends to use technology-adjusted production-based accounting (TPBA) as an alternative to PBA, which will remain as core indicator of regional emissions in the near future.

Assessment of ripple effect and spatial heterogeneity of total losses in the capital of China after a great catastrophe shocks

Topic: (4.2) Input-Output analysis of disasters

Author: Zhengtao Zhang

Co-Authors: Ning Li

Abstract. The total losses caused by natural disaster have spatial heterogeneity due to different economic development level inside the disaster-hit areas(Figure 1). This paper set the scenarios of direct economic loss to introduce the sectors' loss caused by 2008 Wenchuan earthquake into Beijing, utilized Adaptive Regional Input-Output (ARIO) model and Inter-regional ripple effect (IRRE) model. The purpose is to assess the ripple effects of indirect economic loss and spatial heterogeneity of both direct and indirect economic loss at the scale of smallest administrative divisions of China: streets/ (villages and towns)(Figure 2). The results indicate that the district of Beijing with the most severe indirect economic loss is Chaoyang district; Finance & Insurance industry (#15) of Chaowai Street suffers the most in Chaoyang district, which is 1.46 times of its direct economic loss. During 2008-2014, the average annual GDP growth rate of Beijing could be decreased 3.63% affected by the catastrophe. Compared with the 8% of GDP growth rate target, the decreasing GDP growth rate is a significant and noticeable economic impact, and it can be efficiently reduced by increasing rescue effort and priority supporting the industries which are located in the seriously damaged regions.

How to evaluate the reliability of the Regional Input-Output Data? A case for China

Topic: (5.5) Input-Output Accounts and statistics (2)

Author: Haoyang Zhao

Co-Authors: Xu Jian, Jing He

Accurate statistic data are essential to a credible and cogent empirical analysis. For now, however, there is no mature and specialized methodology on how to evaluate accuracy of any input-output (IO) data. This research constructs a comprehensive yet relatively concise framework for evaluating regional IO data accuracy by including several indicators measuring all three quadrants. The framework examines regional IO data from following perspectives: time consistency and variation, coefficient correlation and whether it matches with national level data. A score indicating the overall accuracy as well as detailed information presenting concrete shortcomings of regional IO data could be offered after evaluating by this framework. As an example, the province-level IO data from 90 provinces IO tables in three consecutive session (2002, 2007, 2012) are being analyzed under the above framework. The main contribution and innovation of the research is building the applicable and exhaustive quality evaluation framework for regional IO data. This framework has meanings for both scholars and governments. It enables researchers realize potential flaws in IO data before utilizing it and government statistic agency improve data qualities by avoiding issues emerged in previous data quality evaluation.

Metal Footprint in the context of Investment-led Growth: A Global Time-series Analysis

Topic: (2.5) Special Session: Modelling Sustainable Development: Revisiting Dynamic Input-Output Analysis

Author: Xinzhu ZHENG

Co-Authors: Ranran Wang, Richard WOOD, Edgar Hertwich

In modern society, anthropogenic usage of metals plays an unprecedented role in the process of industrialization and urbanization. Studies indicate a continued growth in metal extraction could risk depleting the reserve base and a continuous decrease in the grade of ores will likely accelerate the impacts of metal extraction on energy demand, water pollution, and land use. The material footprint was introduced as a metric to capture the material use associated with a nation's consumption. Recently, researchers explored the dynamics between metal use and economic development by comparing national metal footprints and GDP. Based on a cross-sectional analysis, Wiedmann and colleagues (2015) reported an elasticity of metal footprint with respect to income of 0.9 for the year 2008. However, these analyses are based on either individual countries or a specific year. Few studies have investigated the relationships between metal footprint and economic activities across a broad range of countries and time. To fill this gap, this study employs panel analysis to investigate the statistical relationships between metal footprint and income (i.e. affluence), urbanization, and capital formation for 43 countries over the period 1995-2013. The analysis employs first difference methods and is based on the STIRPAT (Stochastic Impacts by Regression on Population, Affluence and Technology) model. The first difference model ensures that omitted variables do not unduly influence the analysis and to control for autocorrelation present in the data. Distinct from the relative decoupling relationship reported by cross-sectional studies, our panel data analysis revealed strong positive income-metal coupling for both developed and developing countries. Every 1% growth of per capita GDP (adjusted by purchasing power parity) was associated with 1.74% increase of per

capita metal footprint. A disproportionate share of metal is used for capital formation, and the elastic relationship is due to the growing share of capital formation in GDP as wealth increases. A strong and positive effect of GDP share of capital formation on per capita metal footprint is observed. Controlling for income level, the elasticity of per capita metal footprint with the capital formation share in GDP is 2. While keeping the capital formation share constant, the income elasticity to per capita metal footprint is only around 1. Moreover, urbanization, measured as a country's urban population share, also has significant effects on the metal footprint. As urbanization increases, the metal footprint follows an inverted- U-shaped curve, with a turning point at urbanization = 70%. Findings from this study advance the understanding of resource use drivers from the traditional focus on affluence scale to affluence make-up and suggest that a shift from investment-led growth model to consumption-led growth is a potential pathway to reduce the metal elasticity of economic development.

Finance-Economy Linkage in China During the Global Financial Crisis: An Input-Output Approach

Topic: (8.5) Impact Analysis: Multipliers (2)

Author: Kai Zhu

The development of China's economy and boost of its proportion in global economy highlights the importance of research on factors about its economy stability. The Global Finance Crisis shows the reaction between finance sector and macroeconomy. The direct and indirect output multipliers of financial sector in China illustrates the interaction between financial sector and other industries. Before and after the Global Financial Crisis, the output multipliers changed as a result of change of economic structure.

In this paper, we analyze the change of output multipliers of financial sector before and after the global financial crisis to assess the impact of Global Financial Crisis and the structural change of industries. The declines in the total GDP multipliers by industry provide further evidence that the Global Financial Crisis has a significant effect on capital-intensive sectors.

In this paper, we apply the output multiplier approach, which is based on the input-output model. Two input-output tables of China covering 2007 and 2012 were used. We calculate the direct and indirect output multipliers in 2007 and 2012, compare the change of each industry.

In this paper, we analyze the effect of Global Financial Crisis and financial-economy linkage by an input-output approach, introducing an comparative analysis approach into input-output approach.

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