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Development of Manpower Projection and Assessment Tool (MPAST) for Labor Market Projection in Malaysia, 2021-2030

Topic: Computable General Equilibrium Modeling and Social Accounting Matrices II (Chair: Mun S. Ho, Harvard University)
Author: Mohd Alzaiery ABDUL
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Equipping the labour force with the right skills is one of the policy focuses of any country to support sustainable and inclusive growth. The fact that determination of the future skill surplus and shortage is important for a well-informed and evidence-based policy responses that involve multidimensional interventions such as education and training, international migration and economic sectoral interventions. In the absence of an appropriate analytical tool, it is a great challenge for the policy makers to formulate short- and medium-term planning exercise in a systematic and cohesive manner, thus affecting the quality of policies and strategies to attain socio-economic objective of the country. This paper develops a Manpower Projection and Assessment Tool (MPAST) with the aims to forecast medium- and long-term demand and supply of labors in Malaysia. Essentially, MPAST involves three forecasting components namely labor supply, labor demand and labor market balance (differences between labor demand and supply). MPAST is an Excel-based that applies computable general equilibrium and input-output models as core computational "engine". Because of MPAST involves large structural linkages, various datasets are applied, including macro aggregated and micro data from surveys. The baseline results find that the high-skilled occupations remain the category that projected to have labor surplus while both semi- and low-skilled occupations associate with the labor shortage. The results call for considerable policy interventions to change the economic structure through technological change and upgrading.

Economy-wide impact of climate smart agriculture in India – using a SAM framework

Topic: Regional input-output modeling II (Chair: Vishnu Prabhu, Gokhale Institute of Politics and Economics)
Author: Ananya AJATASATRU
Co-Authors: Kakali MUKHOPADHYAY, Vishnu Sivadasa PRABHU

India is the second largest producer of emission intensive food grain crops; paddy and wheat, and, is the third largest emitter of both Methane (CH4) and Nitrous Oxide (N2O). Hence, in the context of climate change, the Indian agricultural sector treads in a certain duality. The primary aim of this study is to analyze the economy wide impact of climate smart agriculture and its implications of water and carbon footprints in India using a social accounting matrix framework. The climate smart agricultural interventions are classified into two broad categories – first, technological interventions and secondly, the shift in cropping pattern. Both these interventions influence intersectoral linkages between agriculture and non-agriculture sector and therefore, key macro-economic indicators such as, gross domestic product, farm and non-farm income of the households, employment opportunity and fiscal health of the government, also get influenced. The conventional SAM 2017-18 has been extended with climate smart technological practices that are cogent to the principle of agroecology (AE). Conservation Agriculture (CA) and Zero Budget Natural Farming (ZBNF) have been considered as climate smart practices for paddy and wheat which are two most emission intensive and vulnerable crops in India. It was seen that while adoption of the practices prescribed by the ZBNF movement provided the highest changes across

the economy, CA has lesser economic multiplier effect, but has lesser labour requirements with additional capital investment requirements towards funding of mechanized inputs. A shift to alternative crops such as Maize, Sorghum and Millets have enchanced income and output effects, when compared with Wheat. Hence, a combined shift into CA based Rice-Maize cropping pattern is quite plausible. The current study would sensitize policy makers to prioritize suitable policy and institutional measures towards upscaling climate smart interventions in India.

Measuring food-energy-water nexus footprint using a systematic input output approach: case study of Pune, India

Topic: Social accounting matrix and its applications (Chair: Keisuke Nansai, National Institute for Environmental Studies, Japan)
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MEASURING FOOD-ENERGY-WATER NEXUS FOOTPRINT USING A SYSTEMATIC INPUT OUTPUT APPROACH: CASE STUDY OF PUNE, INDIA

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Abstract

The advent of climate change with the recognition of interlinkages, between Food, Energy and Water resource security has brought forth a renewed emphasis on ascertaining FEW footprints of varied policy interventions. In this context, the nexus approach through an IO framework has been crucial towards addressing the interplays and synergies between sectoral flows and their FEW footprint. Furthermore, establishing regional level IO gains relevance particularly in case of developments and policy interventions associated with developing metropolitan regions. While, regional level IO tables are most often not immediately available, hence have to built ground up. Since, rapid urbanization has also been associated with socio-economic inequalities in accessibility to FEW resources. India is currently undergoing great transformations under policy interventions at both economic and environmental front; wherein the country has been attracting investments to expand it’s manufacturing base, while also aiming to transition into a greener economy. The district of Pune particularly is an interesting subject for the NEXUS case study, through a regional IO framework. Since, rapid urbanization, industrial expansion and the accompanying large influx of migrants have put an undue burden on its food, energy, and water (FEW) resources, challenging urban sustainability. Towards this end, this study presents the first-ever district-level economy-wide FEW nexus study in India. The processing sector of the IO transaction table for the Pune district has been prepared along with a separate account of

household expenditures. Results indicate that the most resource intensive sectors in Pune district include agriculture, Manufacturing Fuels, Electricity, Food Processing Sector, Motor Vehicles and Electrical Engineering & Instrument. Pune district's household consumption expenditure is dominated by three sectors: agriculture (34.9%), manufacturing fuels (11.3%) and food processing sector (8.3%). Suggestions have been made for sequential targeting of identified priority sectors in the short, medium, and long run based on comprehensive footprint analysis. Furthermore, the projected rise in Pune's population and expected industrial growth until 2030 indicate that demand for FEW resources is expected to witness triple-digit growth of more than 135% between 2018-30. The consequent FEW burdens of four policy scenarios has also been analysed. The study concludes with important policy recommendations on how alternate development pathways can be leveraged to ultimately reduce the district's overall resource use.

The current status of Uncertainty in EE-MRIO

Topic: Energy Input-Output Modeling I (Chair: Kirsten S. Wiebe, SINTEF)
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Title: The Current Status of Uncertainty in EE-MRIO - Abstract

Presenting uncertainty metrics is instrumental to the bridging of sustainability research and policy. Despite some progress in recent years, uncertainty within Environmentally Extended Multiregional Input-Output models (EE-MRIO) remains an under-researched field. In this research we conduct a literature review on the status of uncertainty estimates in EE-MRIO concentrating on methodological aspects, among others on the data sources for uncertainty estimates and the methods used for calculations. At the same time, we also explore the potential of integrating uncertainty estimates into the python library "pymrio" which enables researchers to receive uncertainty estimates while running their respective models as well as connecting these parameters with EXIOBASE. The research presents two significant results; 1) An overview of the research conducted on uncertainty in EE-MRIO, with regards to the main sources of known uncertainties, 2) A convenient tool that will allow researchers to estimate uncertainties associated with EE-MRIOs. The research is closely related to the overall ambitions of the HiTEA project at NTNU. In general, understanding the nature of uncertainty within EE-MRIO will add robustness to near-term assessments. By giving researchers the tool to readily conduct uncertainty and sensitivity analysis, footprints of specific consumption goods and global supply chain hotspots can be more accurately presented.

Pymrio GitHub Repository: github.com/konstantinstadler/pymrio
HiTEA webpage: hitea.iedl.no

Economic impact of the Next Generation EU funds in Andalusia through a dynamic applied general equilibrium model for 2021-2026

Topic: Computable General Equilibrium Modeling and Social Accounting Matrices III (Chair: Mohd Yusof Saari, University Putra Malaysia)
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Due to the fragility of European economies because of COVID-19 and the need to forecast regional performance for the coming years, the European Council agreed on a temporary instrument called Next Generation EU. It includes 72 billion euros in nonrefundable transfers, of which Andalusia expects to receive at least 18%. In response to the injection of Next Generation EU funds in Andalusia at a time when these resources are being distributed among the Autonomous Regions, it is relevant to analyse their trajectory and impact for the period 2021-2026 in accordance with the Recovery and Resilience Plan presented by the Andalusian Regional Government to the National Government, adjusted to include the latest available information.
This research seeks to measure the economic impact of these funds on the productive activities linked to the recovery plan through a dynamic computable general equilibrium model. This model will make it possible to set the recovery path and guide its implementation based on four scenarios that simulate the behaviour of the main regional economic indicators, what makes our simulation novel. DCGE was calibrated with a SAM built for Andalusia-base year 2016. The simulations indicate that the size of the recovery will depend on the amount received and the sectoral allocation given to these funds; the 18% amount would make it possible to recover the fall in GDP presented; however, all the scenarios reflect a positive impact on household income, consumption, and investment, affecting economic growth and social welfare.

Linking micro-data to national input-output tables: by whom and from whom are which products imported and to what end?

Topic: IO Theory II (Chair: Eva Varga, Hungarian Central Statistical Office)
Author: Timon I. BOHN
Co-Authors: Nieke AERTS, Oscar LEMMERS, Khee Fung WONG

Input-output analysis is usually performed at the industry-level without consideration of how specific products are traded or used by different industries. However, micro-data can be employed to add detailed product and country dimensions and account for heterogeneity in the imports by industry to enrich the analysis. For example, palm oil from Malaysia may largely be imported by one industry (e.g., the food industry) while palm oil from Indonesia may relate to a different industry (e.g., to make biofuel). In addition, different products (e.g., plants and animals) imported from the same industry (agriculture) can have very different emission footprints in environmental analyses. These distinctions are not possible using only aggregated industry-level data. Furthermore, micro-data allows us to identify how different products are ultimately used. The imported palm oil can be used for (1) production for domestic use or direct consumption, (2) production for exports, or (3) re-exports. Using micro data it can be identified that the palm oil imported by a certain industry from a certain country is (mostly) used for production for exports.

Trade policy is typically focused on a detailed product level and not on the aggregated industry-level. That makes this added product-level detail relevant and desirable. This paper

shows how to incorporate this layer of heterogeneity in imports by industry to shed light on how specific products are used in different ways in the value chain, all the way to identifying the exported products in which they are embodied. The potential of integrating micro-data - in particular the detailed international trade in goods and services statistics that are typically available at national statistical offices - into the national input-output table is illustrated by recent experiences of Statistics Netherlands. It allows for a single-country trade in value added (TiVA) analysis with more detail in products, industries and countries.

The complexity of international supply networks and their influence on global income distribution

Topic: Input-output impact analysis (Chair: Keiichiro Kanemoto, Research Institute for Humanity and Nature)
Author: Rosario CERVANTES
Co-Authors: Timur GATAULLIN

Following Shiosawa (2017), we have tried to establish a relationship between the choice of techniques in an economic system and how income is distributed among industries, firms, and households. Using input-output matrices from the WIOD, our results show that, as complex systems, the international supply networks evolved from 2000 to 2014, and these changes affected income distribution. We also show that industries and countries benefit from diversified participation in global production networks as intermediate inputs suppliers. Finally, following some basic network theory concepts, we have developed a method to assess the relative importance of industries and countries in the income distribution/concentration process.

COVID-19 and Income distribution - A case study of South Asia

Topic: Computable General Equilibrium Modeling and Social Accounting Matrices (Chair: Mun S. Ho, Harvard University)
Author: Hadya Fatima CHEEMA

COVID-19, more commonly known as the coronavirus has disrupted the economies around the globe. The impact of this prolonged virus is beyond mortality and morbidity. The outbreak began as
a health crisis which later evolved into a global economic crisis. The control actions measure like restrictions on movement, less labor mobility, and closure of workplaces lead to serious economic implications, especially in the developing world. South Asia – with a population of around
1.7 billion people are hit hard by this pandemic. Against this backdrop, this research quantitatively
seeks the impact of COVID-19 on macro as well as household levels in the case of South Asia. A global computable general equilibrium model is used to quantify the impact of the economic trade
model calibrated with the latest Social Accounting Matrices. This research calculated the complete
lockdown days in which the control actions measure like restrictions on tourism, less labor mobility, and closure of workplaces takes place in South Asia and then use a production shock to quantify the impact on macro as well as household income in South Asia. This research finds that production shock in case of lockdown will hurt the macroeconomic variables like GDP, real imports,

real exports, and government income in the south Asian economies. According to the findings of this
study, South Asian countries should facilitate and prioritize support for exporters identified as having
significant potential by not only ensuring the continuous movement of goods across their supply chains, both foreign and domestic but also by easing their business constraints.

Full-scale, near real-time multi-regional input-output table for the global emerging economies (EMERGING)

Topic: How the rising of emerging economies can reshape the world? I (Chair: Jing Meng, University College London)
Author: Peipei CHEN
Co-Authors: Huo JINGWEN

The multi-regional input-output (MRIO) table enables us to tele connect the sectors in different regions along the supply chain and track both direct and indirect impacts of global fragmented production. It is widely used to analyze the global trade network and conduct environmental research. Emerging economies are playing an increasingly important role in the world economy and reshape international trade patterns. However, current MRIO databases find it challenging to timely reflect the changing world with high country and sector resolution. To bridge the gap, our study presents the up-to-date and full-scale MRIO tables (EMERGING), which covers 135 sectors in 245 economies from 2015 to 2019. We elaborate the comprehensive development steps of how the bilateral trade data and national statistics at the individual country level are reconciled and validated. Moreover, the EMERGING database is expected to incorporate more official and publicly available data from national statistical institutes to ensure a high level of data quality, especially for the emerging economies. We compare both the national production-based and consumption-based value added generated from the EMERGING MRIO with the results of three major MRIO databases. Although global value-added accounts are similar across databases, we find some significant discrepancies at the level of individual countries and sectors concerning conflicting benchmark data.

Inclusive Wealth Footprint for Cities of Japan: Regional clusters for Sustainable Development

Topic: Sustainable production and consumption II (Chair: Shuning Chen, Kyushu University)
Author: Shuning CHEN
Co-Authors: Kenichi KURITA, Takako WAKIYAMA, Shunsuke MANAGI, Shigemi KAGAWA

Abstract: Analyzing city-level sustainability requires measuring the spatial externalities of natural capital and its complex relationship with other socioeconomic capital. This study aims to create a nested Inclusive Wealth (IW) footprint database to study the sustainability of Japanese cities. Inclusive Wealth (IW) estimates natural, produced, and human capital stocks as the productive basis for intergenerational consumption. Footprint calculates capital values embodied in hieratical value chains across cities and prefectures for the current consumption. We applied a municipal-level IW accounting matrix of 2015 to match a flexible high-resolution multi-region input-output (MRIO) database and created the Japanese IW extended nested MRIO. Estimation of the IW footprint includes 1894 cities and 47 prefectures. Three indicators were constructed to analyze the sustainability of Japan's cities: the footprint/endowment impact inequality index, the

forward/backward participation index, and the IW footprint cluster index. The results show that in 2015, 39% of the inclusive wealth in Japanese cities was concentrated in value chains that span prefectures. The value chains of Tokyo Metropolis are responsible for most of the IW clusters in Japan. Still, several prefectures are independent and almost autarky on wealth. We observed evidence of devaluation of natural resources and scarcity of human capital in most prefectures. Based on the above results, we can conclude that improving the efficiency of natural capital use is critical to Japan's sustainability. At the same time, policymakers must carefully consider wealth redistribution in the value chains.
Keywords: Inclusive wealth Indicator (IWI), Natural capital, Nested municipal-level MRIO, Footprint analysis, Hierarchical value chains

Production and numerosity of firms in the era of Covid-19: The case of Marche region

Topic: Computable General Equilibrium Modeling and Social Accounting Matrices II (Chair: Mun S. Ho, Harvard University)
Author: Clio CIASCHINI
Co-Authors: Ian P. CASSAR, Stefano DERIU

Covid-19 pandemics is an extraordinary worldwide phenomenon and a public health crisis that strongly affects the economies all over the world. Consequences of this disruptive disease are observed in income and employment decreases and in interruptions in transport services and in manufacturing industry outputs (Nicola et al., 2020). The Italian Government decree (D.P.C.M) issued the 22nd March 2020, entitled “Urgent measures for the containment of the infection by coronavirus on the whole national territory”, impose the lockdown on the whole national territory and includes several measures pertaining the block of productive activities for specific economic sectors, labelled as “not essential” (Deriu et al., 2021).
Our aim is the evaluation the consequences of a lockdown of the economy of Marche region with reference to both the product typology and the sectoral income redistribution. Within this framework, reference must be made to the entire income circular flow, disaggregated according to the various operators involved in production, distribution and utilisation of income. For these reasons, the most suitable approach for the evaluation of the economic impact of COVID-19 appears to be the economic computable general equilibrium model (CGE) calibrated on a Social Accounting Matrix (Shoven & Whalley, 1984).
Marche region is one of the most industrialised regions of the whole national territory. It is mainly characterised by small manufacturing-oriented firms (shoes, clothing, furniture), in prevalence local. The region’s specialisation in manufacturing sector results in the development of internationally recognised excellent firms, and a regional model of development has been recognised and defined as “Marche Model”.
In the last decade, the economy of Marche experienced a downturn, starting from 2008, in connection with the world economic crisis and, later, as an unwanted result of the “fourth Industrial Revolution”, where the implementation of new productive technologies to increase productivity and the quality of products results in slowdown of occupation. This new growth setting, therefore, seems not to be coherent with the “Marche Model”. This regional productive pattern, in fact, includes low technology production processes and competitive factors not linked to scientific knowledge but more based on learning by doing. Recent economic debate shifts from the traditional Marche Model to a new, more industrialised phase, based on advanced technologies.
At present, the economic situation portrays a productive setting where some critical points emerge. These criticalities have already emerged in the pre-pandemic period and accentuated

during the pandemics, particularly with reference to the number of firms that are active in the market, which exhibits a clear tendency to decline in all the activities (Minsky, 1981). The present fall in GPD, however, does not come with a sharp fall in employment and in the numerosity of firms, thanks to the adoption of ordinary and extraordinary automatic stabilizers (block of dismissals, subsidies to firms and basic income).
The general environment, is, then, characterised by the economic transition with the decrease in the productive block and in demand due to pandemics. Within this framework, many industries perform an increase in the number of active firms in the market. At a sectoral level, the most relevant impact with reference to labour income is experienced by trade, textile, and constructions sectors. With reference to disposable income, institutional sectors undergo considerable difficulties; in particular, a contraction in primary income reduces the taxable amount of taxes and transfers between sectors.
Given that the impact of lockdown is diversified at sectoral level, the economic policy measures should be oriented to preserve the production of the most severely involved sectors, and to protect labour incomes and the related gross operating income, through the reduction of the tax wedge or through transfer measures.

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Net Effects of the Russian invasion of Ukraine on the US Economy

Topic: Input-output analysis for policy making II (Chair: Candi Clouse, Cleveland State University)
Author: Candi CLOUSE

Overview & Research Question
Input-Output analysis has been used since its inception to study the domestic effects of war and even to target disruptions in enemy supply chains (Bollard, 2020, p 193). Coupled with analysis of maps, obituaries, and secret communications, input-output analysis was instrumental in pointed attacks in World War II led by data and intelligence from economists (Bollard, 2020, p 194). While much attention was paid in the early days to learning how to dominate world aggressors through penalties and attacks, there are also huge implications to these policies on the domestic front. In the current global context while Russia is invading Ukraine, countries across the globe are seeing dramatic delays and interruptions in their imports and exports to the warring nations. These

abrupt economic changes, although hopefully short lived, have lasting impacts on regional economies.

Methodology

This analysis will examine the regional winners and losers in the United States from the war in Ukraine using a net analysis coupled with multi-regional input-output analysis. Net analyses report a holistic look at the effects resulting from a change in production or spending in the economy, both the positive and negative. Net analyses that involve two or more different industries will have net winners and net losers beyond just those directly impacted. It is extremely useful to examine both sides in an analysis framing a truer impact picture by not focusing solely on the winners or the losers (Slovachek, 2022).

Using multi-regional input-output (MRIO) analysis, the regionality of economically concentrated places is maintained. MRIO employs interregional commodity trade and commuting flows in order to assess the change in a linked region (Clouse, 2020). Employing this method, the regional concentrations of the affected industries will not only be maintained, but linked out to the other regions across the US.

Data

The first side of this analysis will look at the losses to US businesses from import bans outlined by the United States federal government. Sanctions by industry currently include oil and energy, computers, sensors, lasers, navigation tools, telecommunications, aerospace and marine equipment (Funakoshi, Lawson, & Deka, 2022). Based on the most recent export data from the US Census Bureau - Economic Indicators Division, US exports to Russia were pulled from the list of all exports at the 4 digit North American Industry Classification System (NAICS) code (United States Census Bureau, 2022). These exports total over $1 billion in losses for US firms across 17 NAICS codes.

On the other hand, the United States has also authorized $13.6 billion in emergency aid to Ukraine (Aljazeera, 2022). This includes not only monetary support, but also $1 billion in anti-aircraft and anti-tank weaponry, produced within the United States, in three 4 digit NAICS code industries.

An analysis of the production centers by region for each of the identified industries will be identified. Then, using the IMPLAN data and analysis, a model will be created that will show negative impacts in the industries facing sanctions against Russian exports and positive impacts in the military supply aid being sent to Ukraine (IMPLAN, 2022). These industries will be modeled regionally and linked via Multi-Regional Input-Output (MRIO) analysis. Using this method, the net effect at the national level will be demonstrated, but additionally the regional winners and losers in terms of manufacturing clout via industry will also be ascertained.

Preliminary Conclusions & Novelty

While on the surface, the loss of approximately $1 billion in forgone exports to Russia is offset by the $1 billion gain in new sales going to support Ukraine, the different industries that are affected have distinct supply chains and connectivity within the US and ergo there will inevitably be winning and losing regions across the country.

While this is in no means intended to be a comprehensive examination of the effects of the war in Ukraine on the American economy, the hope is that by looking at what seems to be a dollar-for-dollar loss in exports to gain in domestic manufacturing, a subtle shift in spending patterns will show that certain regions will disproportionately be “winning” while others are

“losing” in times of global conflict. This research hopes to examine the overlap of regionality in terms of the industrial gains and losses across the United States to see if policy interventions might be required to mitigate economic losses to certain places due to international unrest.

Deflation of Input-Output Tables using a Path-RAS approach

Topic: IO Theory I (Chair: Umed Temursho, IOpedia and University of Central Asia)
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Co-Authors: Xesús PEREIRA

Supply and Use Tables (SUT) along time, when measured in current prices, reflect changes in the cost structure of an economy. When technological changes are to be discussed, matrices measured in constant prices are needed. SUTs are usually deflated using a single deflator for each product´s final demand and each industry´s imports. From an economic perspective, deflators are more likely to be cell specific since exchanges of a same good occur in different market and institutional contexts. For the calculation of cell specific deflators, RAS-type procedures were introduced in literature. However, deflating SUTs via RAS can be prevented due to information requirements for the construction of row and column target vectors in constant prices. In this investigation, we revisit the Path-RAS methodology and adapt it to the purpose of price deflation. This way the calculation of cell specific deflators can be done lowering information requirements. The methodology proposed yields a unique, economically meaningful solution. It can also include additional information about specific industries, products or aggregated published figures if available. An empirical application, based on the Galician (NW Spain) regional SUTs is provided in order to explore the accuracy of the estimations obtained. Different information scenarios are explored. In addition, a comparison is established with other methodological proposals present in literature.

The market rigidity hypothesis in a multisectoral CGE approach

Topic: Computable General Equilibrium Modeling and Social Accounting Matrices I (Chair: Stefano Deriu, University of Macerata)
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Co-Authors: Rosita PRETAROLI, Francesca SEVERINI, Claudio SOCCI

Abstract

The use of Computable General Equilibrium Models (CGE) for the impact analysis of economic policies can be considered a best practice for policy makers to get useful indications in the decisional processes. In particular, CGE models calibrated on Social Accounting Matrix represent powerful tools for the quantification of economic implications deriving from the introduction of shocks on the supply side (Deriu, et al., 2021; Severini, et al., 2019), on the demand side (Socci, et al., 2021), and on income distribution (Ciaschini et al., 2013). They are based on solution algorithms that uses a system of linear and non-linear simultaneous equations, which allows determining the vectors of prices and quantities that optimize the utility function of the consumers and the profit of producers under their respective restrictions (budget constraints and production capacity). Therefore, the equilibrium solution allows the balance between the supply and the demand in the markets of commodities and primary factors, according to the assumption of perfect competitiveness of markets.
However, the condition of perfect competition in general equilibrium models does not reflect the

reality of modern economies and might affect the consistence of the simulation results (Harris, 1984). This requires new modeling solutions that incorporate the imperfection of markets, the structural restrictions of the economic system, the sticky prices for selected primary factors and profit margins for activities. In this perspective, two major groups of CGE models have been developed the called macro-structuralist and Neo-Walrasian CGE models (Grassini, 2009). One of the main characteristics of these approaches, is that in selected markets some actors might show a high market power, thus making the prices sticky. This means that selected actors (e.g. producers or primary factors owners) are no more price takers and extra profit can be not null, causing technical implications in terms of production differentiation (De Santis, 2002) and the strategic behaviour of the involved agents (Devarajan & Rodrik, 1991).
In this perspective, this study aims to incorporate the imperfect competition assumptions for selected markets of commodities in a SAM based CGE model for Italy that already encompasses the imperfection in labor market. This would allow computing the impact of policy measures on involuntary unemployment, non-competitive market prices, profits, total output and, more in general, the whole process of income generation, distribution and use. Specifically, the study follows the assumption of the mark-up measure (Roson, 2006), which determines extra profits (rent) by activity, as the price exceeds the total costs. Very often the rent does not lead to investments, but is dispersed for the defence of market power itself (patents, copyrights, etc.) as a result of the reduced interest to innovate and invest when operating in markets characterized by a rigid demand. In this respect, different hypothesis of rent distribution among Institutional Sectors are tested and the simulation results will provide suggestions to the policy maker on the potential distorting effects and distances from expected policy outcomes created by the mark-up.

Keywords: CGE, SAM, Mark-up, Market Imperfection
Jel codes: C68, D58, E16, D41, D43

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Does Input Digitization Promote the Share of Factor Rewards and Their Embedding Depth in the Global Value Chains? —A perspective based on domestic value-added decomposition in export

Topic: Global value chain analysis III (Chair: Carmen Zürcher, OECD)
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This study examines the impact of input digitization on the share of production factor rewards and their embedding depth in global value chains (GVCs) based on the newly constructed indicators of input digitization and factor reward decomposition. We reach the following main results. First, at the country level, input digitization has the potential to significantly improve a country's capital reward share (CRS), labor embedding depth (LED), and capital embedding depth (CED) in GVCs. Second, input digitization has varying effects on labor reward share (LRS) across countries, with positive effects in developed countries but negative effects in developing countries. Third, the empirical findings at the industry-level in China are consistent with those at the country level, which shows industry heterogeneity as well. Input digitization has a positive impact on the LED and CED of China's secondary and tertiary industries, while it negatively impacts the CRS of the primary and secondary industries, as well the LRS of the secondary and tertiary industries. We conclude that promoting the use of digital technology in the production process and creating flexible employment opportunities should be the policy goal for countries seeking to maximize their export trade benefits.

Emphasis on domestic value added in the era of global value chains: evidence from Thailand

Topic: Input-output analysis for policy making (Chair: Jing Meng, University College London)
Author: Wannaphong DURONGKAVEROJ

This paper examines the appropriateness of using the share of domestic value added (value added ratio) of exports in assessing the effectiveness of trade and industrial policy in promoting a pro-poor gain from export. The formal empirical analysis adopts Thailand as a case study, and employs a mixture of input-output analysis and panel econometrics to model the relationship between value added ratio and export performances indicators. The paper utilises Thailand's input-output table covering 74 manufacturing sector for 1990, 1995, 2000, 2010, and 2015. The model is estimated using fixed effect estimator and system GMM. The findings fail to support the relationship between value added ratio and net-export earnings and export- induced income. The results also suggest that value added ratio is negatively related with the labor income share. The upshot is that emphasis on domestic value added runs counter developmental objectives of country's export-led industrialisation in the era of GVCs.

Measuring Technological Change using the Field of Influence Approach to I-O Analysis: Applications to Growth Dynamics in Selected Asian Countries

Topic: Classical IO applications (Chair: Eduardo Moreno Reyes, University of Macerata)
Author: Norman De Guzman DYTIANQUIN

Economic growth in East Asia, dubbed as a miracle story by a World Bank report, has inspired thinking into a new development paradigm in East Asian economies leapfrogging the industrialization process. This miracle story, however, has triggered a debate into the causes of the spectacular economic rise of the Asian economies. This debate on the Asian miracle has crossed various disciplines, spanning the political (democratic versus authoritarian rule) and cultural (Asian values versus Western values) to the economic spheres, where growth accounting studies ushered the economic controversy on accumulation (growth by increase in inputs) versus assimilation (growth by learning new technologies) behind Asia's stellar economic performance. Both results of growth accounting though of 'accumulationists' and 'assimilationists' are based on the neoclassical growth theory of Solow-Swan and depending on the assumptions on parameters such as factor shares and elasticity of substitution propose either way convincing arguments. Endogenous growth theories as well as evolutionary and Schumpeterian approaches have also proliferated in growth literature, challenging the neoclassical explanation for economic growth. Because of the assumptions and limitations of growth accounting, new approaches such as the field of influence technique of input-output analysis, which is Schumpeterian in approach, have recently emerged with promising implications and applications for growth theory.

A key assumption of input-output analysis is that the inverse of technical coefficients are fixed and yet the inverse coefficients change over time. The proponents of the field of influence approach to input-output analysis, i.e., Hewings, Sonis & Jensen (1988) assume that this change in coefficients represent technological change as sectors compete for fixed shares of inputs when producing their outputs resulting from innovation diffusion. This Schumpeterian competition operates in both production (supplying industries) and consumption (buying industries) spheres between new and old products displaying characteristics of the logistics or sigmoid curve where a period of slow growth is followed by rapid and then decelerating growth and consequent decline. Given a longer time series of input-output tables, the changes in coefficients can depict technological diffusion across industries akin to Schumpeterian waves.

In this study, the focus is on economic growth in East Asia (particularly on Malaysia, Thailand and the Philippines), where the field of influence approach was applied over a period of four to five decades. The use of field of influence as a novel approach in studying growth episodes reveals an interesting evolution of the growth dynamics of the selected countries similarly starting out as basically agricultural and yet producing different development trajectories with the type of industries that these economies eventually promoted and developed. The creators of the field of influence approach introduced the calculation of a first order intensity of the direct field of influence of the base year that, in turn, is linked to key sector analysis of backward and forward linkages which can be ranked to form a hierarchy that depicts the economic landscape of countries over time. A second order intensity could likewise be produced, generating scaling effects of inter-sectoral linkages from which bilateral balances and imbalances through push-pull effects of backward and forward linkages are generated. Finally, the propagation of influence through feedback loops can be mapped to see how innovation diffuses throughout the entire economy.
The general purpose technology that propelled technological change in the sample Asian economies is information and communication technology (ICT) represented by the

semiconductor industry classified in the national accounts under electrical machinery where the three countries competed as assemblers in the global supply chain. The semiconductor industry are among three sectors, the other two being transport equipment (automotive) and textiles/wearing apparel, which became archetypes of an emerging development paradigm of global production networks, also referred to as supplier-oriented model of development. The study ends with policy implications in targeting industries that are technology intensive in industrial policy and national innovation systems and in identifying national champions with the right balance among sectors that contribute most to growth and those that minimize vulnerabilities from sectoral or even global-specific shocks. It also indicates the need to graduate into higher value-added phases under the new development paradigm such as developing own brand and design as well as original equipment manufacturing rather than just remaining as assembly, packaging and testing satellites.

Measuring Technology Shocks using the Field of Influence Approach to Input-Output Analysis: Applications to the 1997 Asian Crisis

Topic:
Author: Norman De Guzman DYTIANQUIN

A key assumption of input-output analysis is that the inverse of technical coefficients are fixed and yet the inverse coefficients change over time. The proponents of the field of influence approach to input-output analysis [i.e., Hewings, Sonis & Jensen (1988)] assume that this change in coefficients represent technological change as given a fixed share of inputs equaling unity, sectors compete for shares of inputs when producing their outputs. The field of influence approach comprises equations that simply show that the matrix of technical coefficients for a given year should equal the sum of three parts: a) the matrix of technical coefficients of a reference year arranged as a direct field of influence where the entire matrix is just the product of all elements rearranged into row and column vectors; b) the total product of the direct field of influence matrix multiplied by the sectoral changes in technical coefficients; and c) the synergetic effect of both parts above calculated by multiplying the direct field of influence matrix by the reciprocal of the ratio of the determinant of the original (reference or base year) inverse matrix of technical coefficients to the determinant of the matrix of changes in the technical coefficients between the base year and the year under study. Given a longer time series of input-output tables, the changes in coefficients can depict as well waves of technological diffusion across industries.

The application of the field of influence approach can be extended not only to investigate the role of technology in growth episodes but the propagation of economic shocks in line with real business cycle or RBC theory. While most episodes of economic crisis are driven by monetary impulses, RBC theory looks at technological shocks as alternative explanation to why economies fluctuate with resulting effects on productivity. Relating the change in coefficients to economic crisis, the conceptual framework uses network theory where propagation of sector-specific shocks analogous to new technologies diffusing across sectors in the case of growth, spreads like a virus throughout the economic system through a web of sectoral interdependencies in the case of crisis. This propagation mechanism which is conceptually associated to RBC theory could moreover be linked to the bullwhip effect where upstream or supplying sectors are adversely affected by supply shocks and downstream or buying sectors by demand shocks. The bullwhip effect shows the cyclical sensitivity of sectors across the supply chain to business cycles, with upstream or supplier industries most affected due to demand uncertainty and problems

associated with forecasting demand and the need to supply buffer stocks to satisfy this demand downstream.

The study focuses on three developing economies affected by the 1997 Asian crisis – Malaysia, Thailand and the Philippines – and applies the field of influence approach to this crisis episode. The debate on the origins of the Asian crisis revolves around the structuralist/fundamentalist versus the contagion/panic positions where the former adheres to the view that these Asian crisis economies are macro-economically flawed as evidenced by balance of payments deficits, short term external debt accumulation, banking troubles beset with property bubbles and corporate governance problems. The opposing view believes in a pure contagion occurring from asymmetric information notwithstanding economic fundamentals remaining sound. While both sides to the debate indicate the Asian crisis episode as monetary in substance, there was no role ascribed to real shocks in attempting to explain the causes of the Asian crisis consonant with RBC theory.

Using two models of the network propagation mechanism of RBC theory, the economic crisis that befell these three economies in 1997 could be played out by supply shocks. These supply shocks were pronounced in the semiconductor industry classified in the national accounts under electrical machinery where the three countries competed as assemblers in the global supply chain. The semiconductor industry are among three sectors, the other two being transport equipment (automotive) and textiles/wearing apparel, which became archetypes of an emerging development paradigm of global production networks, also referred to as supplier-oriented model of development. Possible supply shocks that impacted the semiconductor industry were the rapid miniaturization of the microchip in the latter half of the 1990s in accordance with Moore's law, the emergence of China as a favorite destination for foreign investments in the electronics industry, the drop in electronics prices and the Japanese property bubble in early 1990 that affected supplier industries in terms of tighter financing and shrinking capital flows of Japanese banks into Japanese corporations that purchased these chips from the Asian economies.

Dynamics and regional heterogeneity in power generation efficiency of PV power plants in Japan focusing on new market entrants

Topic: Productivity and efficiency analysis II (Chair: Douglas S. Meade, Inforum)
Author: Shogo EGUCHI
Co-Authors: Yuya NAKAMOTO, Hirotaka TAKAYABU

In Japan, renewable energy sources supplied 21.2% of the total electricity generation in 2020. The Japanese government plans on increasing this ratio to around 36 - 38% by 2030. In this situation, Photovoltaic (PV) power generation will play a significant roll and a large number of new entrants in the market is expected. On the other hand, it is widely known that electricity generation in PV systems fluctuates depending on factors such as weather conditions, seasonality, and location of the power plant. Moreover, in Japan, where the sites for building PV systems are limited, it is essential to improve and stabilize the power generation efficiency of PV systems at plant levels.
In the light of these research backgrounds, by applying a combined research framework of metafrontier Data Envelopment Analysis and global Malmquist index to the data on PV power generation in Japan at plant levels between 2017 and 2020, this study investigates the following three questions: (i) When dividing the whole of Japan into three parts (north, east and west), is there a significant regional gap in changes in power generation efficiency during the study period? (ii) Which of 'catch-up' and 'frontier technology shift' effects would mainly affect the

changes in power generation efficiency? (iii) How new market entrants would have an impact on power generation efficiency?
During the study period, our results show that power generation efficiency in north, east and west regions is increased by 13.6%, 38.9% and 19.4%, respectively. The catch-up effect is the main driver of the substantial efficiency improvement in the east region, while the frontier technology shift effect mainly affects the changes in power generation efficiency in the north and west regions. Furthermore, new market entrants contribute to increasing the average power generation efficiency especially in the west region.

Conventional Input-Output models to estimate economic damage of earthquakes.

Topic: An Input-Output Analysis for Disaster Damage: A Case Study on the Tokyo Epicentral Earthquake (Chair: Kiyoshi Fujikawa, Aichi Gakuin University)
Author: Kiyoshi FUJIKAWA
Co-Authors: Mitsuru SHIMODA, Takatoshi WATANABE

This presentation is the first presentation in the organized session, “An Input-Output Analysis for Disaster Damage: A Case Study on the Tokyo Epicentral Earthquake”.
An earthquake of magnitude seven or greater in the southern Kanto region, including Tokyo, is expected to cause more direct damage than the Great East Japan Earthquake in 2011. A reduction in economic activity in Tokyo would cause significant economic damage to the rest of the country since Tokyo is the center of logistics. This session will focus on such indirect damage, where Tokyo is assumed as the disaster area and exogenous to measure the production decrease caused by the disaster in Tokyo. The entire Japan is divided into two regions, Tokyo and the rest of Japan, and we estimate the extent to which the damage in Tokyo extends beyond Tokyo based on Tokyo metropolitan two-regional Input-Output table.
In this presentation, we present a demand-oriented model, a supply-oriented model, and a hybrid demand. This presentation is important in the sense that the results obtained can be compared with those obtained with other models in the same session although the ideas of these models are relatively well known and the models themselves do not have much novelty. In the demand-oriented model, the exogenous variable is the decrease in intermediate demand from Tokyo due to the production decrease in Tokyo. The resulting decrease in production outside of Tokyo is the damage caused by the earthquake. In other words, this is the backward linkage effect of the decrease in production in Tokyo, which is estimated by Leontief model. In the supply-oriented model, we apply the Ghosh model, in which production is determined as the sum of inputs (intermediate goods and value added). What is considered fixed in this model is the allocation coefficient from one industry to others. The Tokyo disaster reduces inputs to the rest of the country. The model measures the forward linkage effect of the decrease in production in Tokyo, which is then considered as the damage. The hybrid model uses both. In the first step, the forward linkage effect expressed by the Gauche model is activated, and from the second step, the backward linkage effect by the Leontief model is activated.

The role of embeddedness on regional economic resilience

Topic: Computable General Equilibrium Modeling and Social Accounting Matrices III (Chair: Mohd Yusof Saari, University Putra Malaysia)
Author: Simone Maria GRABNER
Co-Authors: Andre CARRASCAL INCERA, Tasos KITSOS

We study the role of local industrial embeddedness on economic resilience to the 2008 Great Recession (GR) in 256 NUTS2 regions. The GR had profound effects in regions, which showed divergent experiences based on their capacity to avoid or overcome the shock. Economic resilience has been brought to the centre of attention with several contributions on its determinants. However, the embeddedness of local economic systems in terms of sales and supplies and their effects on economic resilience have been largely unexplored. This paper aims at filling this gap using regional input-output tables to approximate the embeddedness of local economies between 2000 and 2010. Results suggest that during the GR, regional industries opted to change input rather than output markets whilst the embeddedness of their sales had a curvilinear relationship to regional resistance to the recession. These findings differ across sectors.

Environmental responsibility and exposure of finance: combining Environmentally-extended Input-Output and Balance Sheet approaches

Topic: Methodological aspects of input-output analysis (Chair: Bart Los, University of Groningen)
Author: Paul HADJI-LAZARO

Finance both contributes to environmental degradation and is vulnerable to environmental degradation. This article sets the methodological groundwork for assessing both concerns in an integrated macro-accounting framework. It is presented how the combination of Environmentally extended Input-Output analysis and balance sheet methods and data can be used to evaluate the contribution of finance to environmental degradation (responsibility) and the vulnerability of finance to environmental risks (exposure). The paper interprets the notions of environmental responsibility and exposure of finance (with an emphasis on transition risks) in a framework combining EIO and BS approaches, and provide methods for assessing them in such a framework. The paper also illustrates the methodological contribution in an empirical case study based on the EXIOBASE MRIO database and an industry-level financial database from the European Central Bank (called BACH). Ultimatly, the article contributes to the development of a disaggregatted ecological macroeconomy integrating monetary and biophysical flows and stocks.

The usefulness of Japan's extended input–output tables incorporating firm heterogeneity

Topic: Handbook on Extended Supply and Use Tables I (Chair: Jose M. Rueda-Cantuche, European Commission)
Author: Satoru HAGINO
Co-Authors: Jiyoung KIM

This study examines the usefulness of an extended input–output table (EIOT) incorporating the heterogeneity of Japanese firms based on differences in ratios of imported intermediate goods to

total output. Using an EIOT, the vertical specialization indicator
of Japan was calculated, which corresponds to the foreign value added included in exports. In this process, differences in intermediate input ratios were measured examining different types of firms using firm-level microdata from the Basic Survey of Japanese Business Structure and Activities. The results indicate that distinguishing between exporting and non-exporting firms is relevant for assembly industries such as electronics and automobiles, as widely discussed in the literature. In contrast, for primary materials industries, such as paper, chemical, and metal industries, other distinctions appear to be more relevant. For example, for the chemical industry, firms tend to have large, integrated manufacturing plants, and thus the differences in intermediate import ratios are largest when distinguishing large firms from small and medium firms. For paper and metal industries, firms tend to rely on foreign raw materials, and thus the difference is largest when distinguishing between firms with and without foreign affiliates. By incorporating such heterogeneity, the vertical specialization indicator increases by 70%; thus, the EIOT captures the foreign value added more comprehensively.

Measuring regional value chains

Topic: Classical IO applications (Chair: Bernhard Michel, Federal Planning Bureau of Belgium)
Author: Xue HAN
Co-Authors: Norihiko YAMANO

Global value chains analysis using global Input-Output tables captures the direct and indirect economic dependencies across countries in both backward and forward directions. Regionalisation of production networks has been a recognized trading pattern in terms of increasing regional trade agreements and stronger connections along global value chains. However, the existing studies measuring regional trade and TiVA network analyses may not fully capture the role of regionalisation in global value chains. This paper provides a novel and more comprehensive framework to decompose production chains into three components: (1) national production chains; (2) intra-regional production chains, regional production chains excluding national ones; (3) extra-regional global production chains, global production chains excluding national and regional chains. Based on this model, we build regional value chains indicators, including backward linkages, regional value-added content embodied in exports and forward linkages, and domestic valued-added embodied in regional value chains. We also calculate the production length in regional value chains to help understand the production of goods and services within regional value chains compared to production within global value chains. Using the 2021 edition of OECD's Inter-Country Input-Output database (ICIO) for the period 1995 to 2018, we show supply and demand networks along regional value chains for six selected regions. Regionalisation effects are much more significant along regional value chains given that, on average, regionally made products are mostly consumed within the region, and regional foreign value-added are mainly embodied in regional value chains. The intra-regional cross-border production networks are most integrated in Europe, particularly in the Eurozone countries. The breakdown of national, regional and global value chains helps a better understanding of the heterogeneous patterns along national, regional and global productions in terms of energy intensity, input concentration, production length, and risk resilience. Global production chains tend to be more energy-consuming than regional production chains while national production chains are generally cleaner than cross-border production chains. Moreover, regional value chains turn out to be more stable and resilient to external shocks.

The role of health-care sector in Malaysia's national economy: An input-output analysis

Topic: Classical IO applications (Chair: Eduardo Moreno Reyes, University of Macerata)
Author: Manjeet Kaur HARNEK SINGH
Co-Authors: Bawani LELCHUMANAN

Driven by a rise in non-communicable diseases and demographic changes, the growing demand for healthcare in Malaysia, coupled with the unprecedented challenges imposed by the Covid-19 pandemic, calls for a greater focus on the healthcare sector. While the government has taken many steps to improve its healthcare system, the economic significance of the healthcare sector has yet to be quantified and evaluated. The healthcare sector plays an important role in the economy through its expenditure on employment and procurement of medicines as well as other inputs. The growing trend in health spending is transforming health care into a significant sector in economies, creating an even stronger connection with economic growth. Nonetheless, health spending drains public finances and creates pressure on policymakers to maintain the budget. Therefore, to provide strong arguments for investing in health, the importance of the healthcare sector in the economy needs to be carefully evaluated. This study aims to explore the impact of the healthcare sector on the Malaysian economy and its interdependence with the rest of the sectors using input-output analysis. Based on Malaysia's input-output tables for 2010 and 2015, this study disaggregates the healthcare sector into private and public health care and assesses the impact of the healthcare sector by determining the inter-industry linkage effect as well as the employment, value-added, and output multiplier. Based on the value-added multiplier, an additional RM1 of final demand in the healthcare sector results in RM0.81 of value-added to the overall economy. The findings imply that the healthcare sector has increasing backward linkages over time, as well as prevailing positive effects on the economy via value-added and employment multipliers. Therefore, the healthcare sector in Malaysia has the potential to play a significant role in the growth of the economy.

Keywords: Input-Output analysis, health-care, multipliers, Malaysia,

Development of MAC-GREEN for Green Economy Assessment in Malaysia

Topic: Computable General Equilibrium Modeling and Social Accounting Matrices III (Chair: Mohd Yusof Saari, University Putra Malaysia)
Author: Muhamad Zharif Luqman HASHIM
Co-Authors: M. Yusof SAARI, Muhammad Daaniyall ABD RAHMAN, Syamsul Herman MOHAMMAD AFANDI, Chakrin UTIT

Integration of the economic, environment and social is the key in the green economy pillars that aimed to achieve sustainable development targets. There is, in general, widespread acceptance of why the integration of these three pillars is necessary; but there are also many questions as to "how" this integration to be achieved and monitored. This paper develops an Excel-based Macro Model on Green Economy (MAC-GREEN) that is specifically designed as a computational tool for baseline and simulation analyses on the green economy in Malaysia for the periods 2020-2040. The MAC-GREEN is built based on augmented Input-Output-Econometric models that inter-connections between four blocks of structural relationships—economic, social, environment and policy responses—with gives 35 green economy indicators in total. There are three main datasets used to run the MAC-GREEN which include monetary national accounts data (e.g.,

input-output tables and social accounting matrix); monetary and non-monetary socio-economic data (e.g., employment and wages); and monetary and non-monetary environmental data (e.g., water and wastewater treatment cost). Results for the baseline projection indicate that there is existence of decoupling among selected economic, social and environment indicators. For example, decoupling trend is found between gross domestic product, solid waste and CO2 emission, which implies that the economy is developed with less harm on the environment.

Discovering fixed-capital categories resulting in significant material and carbon footprints, with application to Japanese material flow

Topic: Consumption-based accounting (Chair: Bart Los, University of Groningen)
Author: SHO HATA
Co-Authors: Keisuke NANSAI, Kenichi NAKAJIMA

Production and services in modern society are supported by fixed-capital, such as production facilities, infrastructure, and durable consumer goods, in which large amounts of resources are invested. Considering that material use triggers substantial carbon emissions, understanding the relationship between the materials consumed via fixed-capital formation and carbon emissions is a prerequisite for achieving climate change targets. We developed a fixed-capital endogenizing input-output model to calculate capital-embodied material footprints (MF) and their induced carbon emissions. Decomposing the capital-embodied MF into two supply chain effects (production and fixed-capital formation) allows us to separate the supply chain effects to material use and carbon emission. To apply the model to the 2015 Japanese economy, we developed an original material flow database. As the result, we identified that the fixed-capital supply chains were responsible for 454 million tons MF, which account for one-third of the total MF induced by household consumption. The carbon emissions per unit MF of the fixed-capital supply chain, 0.46 t-CO2eq/t, was as much as half of that of the production supply chain. The fixed-capital supply chain for the service sectors caused 168 million tons MF and indicated the high level of carbon intensity among nine fixed-capital supply chains. Our findings highlight that breaking the stimulus to the fixed-capital formation by service industries is imperative for curbing material use and carbon emissions. Strengthening circular economy policies and companies' and cities' Scope 3 carbon management, focusing on fixed-capital, will be instrumental in driving this change.

Analyzing Carbon Pricing Policies using a General Equilibrium Model with production parameters estimated using firm data

Topic: Computable General Equilibrium Modeling and Social Accounting Matrices II (Chair: Mun S. Ho, Harvard University)
Author: Mun Sing HO

Computable General Equilibrium (CGE) models are extensively used in simulating important environmental policies, such as carbon taxes or cap and trade policies. The simulation results from these models hinge on the production functions and the elasticities of substitution among inputs such as capital, labor and energy, or sub-tier substitution among different energy types. Many CGE models rely on parameters that are derived from other countries, other industries or from earlier periods given the difficulty in obtaining them; a common source of parameters is the GTAP database which is carefully compiled but only has a small set of elasticities.
China has ambitious carbon policies and given its major contribution to global emissions, these

policies are much analyzed and discussed. In the empirical studies of these policies, there are few studies of production functions with energy input using firm-level data. We use firm level data, and the Ackerberg-Caves-Frazer method to estimate CES production functions by industry and find significant heterogeneity in substitution elasticities across different industries. We then incorporate these empirically estimated elasticities into the CGE model to simulate carbon price policies to reach China's NDC targets in 2030. We compare simulated results using GTAP parameters and our empirically estimated coefficients. We find our empirical CGE model project lower base case GDP growth and higher total energy use, but with lower coal use and carbon emissions. In the carbon tax exercises, we found that empirical parameters would cause slightly larger GDP loss and greater energy use and carbon emission reductions, compared to GTAP parameters. Finally, we also conduct a sensitivity analysis applying empirical parameters in limited sectors to test the model sensitivity.

Mapping the deforestation footprint of nations

Topic: Input-output impact analysis (Chair: Keiichiro Kanemoto, Research Institute for Humanity and Nature)
Author: Nguyen Tien HOANG
Co-Authors: Keiichiro KANEMOTO

An unprecedented increase in the number of Amazon rainforest fires coupled with the pressure of economic development has become a major global concern at the turn of the new decade. Although the relationship between deforestation and global supply chains has been confirmed in the literature, how the spatial patterns of deforestation are embodied in international trade is still poorly understood. Using remote sensing data and multi-region input-output model, here we quantify and map the spatial-temporal changes in global deforestation footprints over 15 years (2001–2015) at a 30-m resolution. While obtaining net forest gains, China, India, and the G7 countries (except for Canada, in which forest cover area is decreasing) have increased the deforestation footprints outside their borders. We find that tropical countries (e.g., Brazil, Madagascar, Argentina, Indonesia, and Côte d'Ivoire) majorly export forest-risk commodities (e.g., cattle, soybeans, coffee, cocoa, palm oil, and timber) to the G7 countries and China. Residents in the G7 countries drive an average loss of 1.4–16.1 trees or 25–152 m2 of forest yr-1 per capita through their consumption in 2015. We suggest that the zero-deforestation policies need to be reformed to improve transparent monitoring of the supply chain and promote effective public governance as a platform for developing private initiatives in the long term.

Investigating Sustainable Urban Structures toward a Decarbonized Society

Topic: Sustainable production and consumption I (Chair: Shigemi Kagawa, Kyushu University)
Author: Chisato HOSOSHIMA
Co-Authors: Shigemi KAGAWA

With the adoption of the Paris Agreement in December 2015, efforts are now being made to decarbonize on a global scale, and Japan has also declared its goal of achieving carbon neutrality by 2050. In order to achieve this goal, each a municipality is required to reduce CO2 emissionspromote through specific policies. However, since there are significant differences in urban structures in each municipalityregion, the policies that should be implemented for decarbonization differ across from one municipalitiyes to another. This study estimates the

impacts of different spatial structuresstructural differences between rural and urban areas on life-cycle CO_2 emissions from private vehicles, and examines effective urban structures in reducing CO_2 emissions, in order to determine how to achieve sustainable cities. To analyze how CO_2 emissions from private cars change due to after the development level of public transportation, an econometric multiple regression analysis at prefecture level in 2020 was performed by using the annual CO_2 emissions per driver (t-CO_2) in prefecture i (i=1,2,...47) as the an objective variable y_i,, and the percentage of electric vehicles among passenger cars, the number of train station per land area, the number of bus stops per land area, the percentage of drivers over 75-year-old who have returned their licenses, the number of stores per land area, the dependence on private cars, and the average number of walking steps taken per day in prefecture i as the explanatory variables x_1i,x_2i,x_3i,x_4i,x_5i,x_6i,and x_7i. Subsequently, the spatial econometric analysis framework was combined with a multi-regions input-output analysis framework of the Japanese prefectures. Thise study analysis demonstratedshowed that an increase in the number of train stations and bus stops considerably contributed to decreasreducinges life-cycle CO_2 emissions from private vehicles. This is because the development of public transportation makes it possible for each individual to lead a lifestyle n adequate life without driving a car. For CO2 mitigation, we It was also found that increasing the number of stations and bus stops is more effective in cities than in rural areas. Theis sustainability estimated analysis frameworkmodel at prefecture level proposed in this study can help each municipality to determine the most suitable urban policy toward the decarbonization.

Why should you blame your neighbor? A Multi-Regional Input–Output Analysis of emissions embodied in China’s international trade

Topic:
Author: Yongming HUANG
Co-Authors: Xiaoli NAN, Yanan ZHANG, JAMAL KHAN

This paper departs from existing literature by estimating, within the same framework and not separately, emissions transfers of air pollutants (APs) and greenhouse gases (GHG) from its trading partners to China using a Multi-Regional Input-Output model. Utilizing the data from the WIOD over the period 1995 to 2009, we analyze both China’s environmental cost relative to its gains from international trade, with a pollution terms-of-trade indicator, and the key drivers of emissions embodied in its net exports, with a spatial-index-decomposition analysis. We obtain three main results. First, from one seventh to one fourth of both APs and GHG emissions in China were due to foreign consumption in 2009. Between 27-39% of GHG and 23-68% of APs of the developed-world consumption-based emissions occur in China. Second, China has been paying larger environment costs than its trade partners to achieve the same value-added through exports. Third, China’s emission intensity has been the major driver of embodied emissions in its net exports, with a lower contribution of the other two factors, trade balance and specialization. The link between climate change and air quality—co-benefits and trade-offs—should be considered jointly in the policy process.

Carbon Footprint of Residential Construction Technologies in Japan

Topic: Input-output analysis for policy making II (Chair: Candi Clouse, Cleveland State University)
Author: SEIYA IMADA
Co-Authors: Shigemi KAGAWA, Keitaro MAENO

To mitigate climate change, the residential building sector needs to reduce not only CO2 emissions caused by direct energy use phase at home but CO2 emissions triggered by construction supply chains. In 2020, 820000 units of houses were newly built in Japan. In the same year, the number of new wooden houses was 470000 units, accounting for approximately 60% of the new housing starts and thus the demand for wood-frame housing is higher in Japan. This study focuses on three types of technologies of wood-frame construction, steel-framed reinforced concrete (SRC) construction, and reinforced concrete (RC) construction and determines a functional unit of total floor area of an 'average' house constructed by the specific technology. Based on the Construction Input-Output Table (CIOT) provided by the Ministry of Land, Infrastructure, Transport and Tourism and the Embodied Energy and Emission Intensity Data (3EID) for Japan Using Input-Output Tables provided by the National Institute for Environmental Studies of Japan, we estimated the carbon footprint from supply chains formed by constructing an average house with 113 square meters by the specific construction technology (i.e., wood-frame technology, SRC technology, and RC technology). Subsequently, we used a unit structure model with a focus on the specific construction technology and identified CO2 hotspots in the construction supply chains. We found that the wood-frame technology contributed to increasing the carbon footprint during the study period between 2005 and 2015 due to growth of CO2 hotspots for material sectors. It is crucial to implement a policy to reduce supply chain emissions with a focus on the CO2 hotspots identified in this study.

A Risk Analysis on the Network Concentration of Global Supply Chains

Topic: Structural Decomposition Analysis (Chair: Bart Los, University of Groningen)
Author: Satoshi INOMATA
Co-Authors: Tesshu HANAKA

The world economy in the 21st century has given rise to a new production arrangement known as global value chains (GVCs), in which production processes are sliced and relocated to places where the corresponding tasks are most efficiently performed. Due to the rapid advancement of transportation modes and information and communication technology (ICT), production networks continue to expand to cover every corner of the globe. Concurrently, the pursuit of optimal allocation of resources often results in the agglomeration and concentration of key production capacities in a certain region of a certain country.

This may work well in an ordinary environment, but when circumstances change for the worse, such production hubs can become "choke points" of the entire economic system. Multiple examples can be found in recent history: the Lehman Shock, the Great East Japan Earthquake, and various forms of cyber-attacks, where hyper economic interdependency rendered production and financial systems particularly vulnerable to a single point of failure.

This series of incidents has driven our attention to the systematic risk associated with the skewed concentration of supply chains in global production networks. The flow of goods, money, people, and information jointly form a highly complex nexus of economic activities, and a shock generated in a core region may rapidly and extensively propagate to other regions across national borders in an unforeseeable manner.

Against this backdrop, we propose a novel approach to construct a risk indicator for firms' business operations, especially in a global context, by mapping the degree of network concentration of supply chains. This is done along a line of traditional techniques in input-output economics known as the "key sector analysis," yet with methodological augmentation by a compatible analytical framework in network theory.

The OECD's Inter-Country Input-Output Tables are chosen as analytical data. The latest version, published in 2021, is based on 45 industries (concordant with ISIC Rev.4), covering 66 countries/regions from 1995 to 2018, allowing comprehensive time and geographic coverage for GVC analyses

The novelty of this study is that we measure concentration risks in terms of the frequency with which a particular supply chain passes through a high-risk region, as opposed to the conventional approach based on a volume concept. If the analysis is directed to supply chain disruptions (such as natural disasters or geopolitical conflicts), then the measurement will reveal the degree of supply chain vulnerability to unpredictable incidents in the region of analytical concern.

Comparative analysis of endogenization methods of the final demand component parts

Topic: Regional input-output modeling I (Chair: Everlam Montibeler, The Federal Rural University of Rio de Janeiro)
Author: Rustam ISHBULATOV
Co-Authors: Vildan GAIAZOV, Rustam ISHBULATOV

The paper studies different approaches to the closing of Input-Output models by endogenization of component parts of the final demand. The authors proved that the closing of the Input-Output model through the transfer of certain columns of the final demand and the corresponding rows of value added into the table of interindustry flows of goods, provided that certain conditions are met, is equivalent to round-by-round calculations with the classic (open) Input-Output model. Considering a particularly acute problem of information content for regional Input-Output tables, approbation of different approaches was carried out taking as an example data from the regional Input-Output table (for the Republic of Bashkortostan, Russian Federation). Household consumption, which is the major part of the final demand, is considered as the endogenized component part. Apart from the two indicated variations of household consumption endogenization, more complex modifications of the classic Input-Output model are being studied including equations for the generation and distribution of income and industry demand volumes, also taking into account separate assessment of final consumption due to natural economy and final consumption due to cash incomes of the population. Based on an empirical analysis of different calculation options, the possibilities of using certain models depending on the availability of regional statistics and the problems solved with the help of the models, are studied. A comparative analysis of the calculation results is also carried out based on various model options for the national economy of Russia.
Keywords: open models and closed models, remaining final demand, regional IO models.

Measuring I/O-Production in DIGITAL ECONOMY

Topic: IO Theory II (Chair: Eva Varga, Hungarian Central Statistical Office)
Author: Emmenegger JEAN-FRANçOIS
Co-Authors: Hassan Ahmed Nour ELDIN

(1) Productivity is an all-power measure of a national economy and stays beside the main aggregates of the system of national accounts, as the national income Y (a proxy of GDP), the total output X and the circulating capital K, which is the total value of the means of production. -- In this paper a notion of the measurement of the productivity of an economy, also called the productiveness of the economy, is proposed. Two algebraic properties have to exist. The first property (a) has to guarantee that the theorem of Perron-Frobenius can be applied to the appropriate matrices of a production system, as the commodity flow matrix, appearing in Input-Output Tables (The Perron-Frobenius theorem says that for a non-negative irreducible n x n matrix, there exists always a maximal, real and positive eigenvalue, the Frobenius number, to which is associated a positive eigenvector.). The second property (b) has to guarantee the productivity of the economy, i.e., the vector of final demand is semi-positive.

(2) mathematics and computations with Mathematica

(3) World Input-Output Tables developped by the Groningen University, Netherlands (Germany, Austria, Switzerland)

(4) In this paper a notion of the measurement of the productivity of an economy, also called the productiveness of the economy, is proposed.

Impacts of decent living on national and global carbon emissions

Topic: How the rising of emerging economies can reshape the world? II (Chair: Jing Meng, University College London)
Author: Huo JINGWEN

There is growing international awareness of the need to promote everyone’s basic living standard. In order to assess the environmental impacts, we quantify the global CO2 emission embodied in the material underpinnings of decent living standards (DLS) in providing decent food, clothing, housing, sanitation, health, education, water, electricity, mobility and ICT within countries. There are considerable gaps in DLS across the world, especially between developed countries and emerging countries. Many countries have formulated national emission limitation contributions (EMCS) for reducing the emissions. For emerging countries, due to the low proportion of population’s living has meet DLS in 2019, more carbon emissions may be required for achieving DLS in the future, which may have a great possibility of the failure of the emission reduction targets proposed by the country. The results provide quantitative evidence currently lacking and critical to policy decision making about achieving DLS in a carbon-constrained world.

Carbon footprint of cities based on micro-consumption data

Topic: Consumption-based accounting (Chair: Bart Los, University of Groningen)
Author: Keiichiro KANEMOTO
Co-Authors: Jemyung LEE, Daniel MORAN, Yosuke SHIGETOMI

Given that national pledges are likely insufficient to meet Paris greenhouse gas (GHG) reduction targets, increasingly actors at the city and state level are looking for options on how local government can contribute to reducing GHG emissions. For a typical city only one third to half of their carbon footprint (CF) is emitted within the jurisdiction, while the majority is embodied in goods and services flowing into the city. To support well-informed mitigation efforts, administrators need robust inventories of both direct emissions as well as the supply chain emissions. Here we construct household CF inventories for cities in Japan, India, the European Union (EU), and Indonesia using detailed consumer expenditure data from hundreds of thousands of households and a multi-regional input-output (MRIO) model. Our city-level CF database includes 1172 cities in Japan, 623 cities in India, 76 cities in the EU, and 514 cities in Indonesia (see https://city.spatialfootprint.com/). We identify the consumption activities (food, electricity, gas, other energy, medical care, public transport, education, consumable goods, durables goods, other services) which city policymakers can target to reduce CF. Understanding a city's consumption-based CF of households in addition to its direct emissions exposes additional policy options for each citizen to contribute to achieving national goals.

A Brief Introduction of Scientific Thought, Theory and Method of “Real-Time Input- Output Tabulation Method”

Topic:
Author: Ning KANG

The contribution of the scientific thought, theory and method of “Real-time input-output tabulation method” to human society, 1) based on information technology, the tabulation method has been established to gather the basic data needed for the real-time analysis of the optimal micro material-based input-output planning model, and it can objectively reflect the actual situation of the enterprise environment and production activities at the time of the planning period; 2) the tabulation method has been established to gather the basic data needed for the timely analysis of the micro material-based input-output statistical model, therefore, not only can the implementation of plans be tested, the actual situation of the enterprise environment and production activities at the end of the plan can also be objectively reflected; 3) based on the real-time analysis of the optimal micro material-based input-output planning model and the timely analysis of the micro material-based input-output statistical model, the tabulation methods can be established to gather the basic data needed for the real-time analysis of optimal micro value-based input-output planning model and timely analysis of micro value-based input-output statistical model; 4) based on the real-time analysis of the optimal micro material-based input-output planning model and the timely analysis of the micro material-based input-output statistical model, as well as the optimal micro value-based input-output planning model and the timely analysis of the micro value-based input-output statistical model, the tabulation methods can be established to gather the basic data needed for the real-time analysis of optimal macro material-based input-output planning model and timely analysis of macro material-based input-output statistical model, as well as optimal macro value-based input-output planning model and timely analysis of macro value-based input-output statistical model;5) oriented by market demand, the scientific methods can be established to automatically complete tabulation as well

as its application by combining Big data, new Cloud Computing technology and AI technology. In addition, from Material Requirements Planning (MRP) to Manufacturing Resource Planning (MRPII) then to Enterprise Resource Planning (ERP) and lean production which consists of demand, production and supply. In agile manufacturing, information integration and synchronous operation among virtual factories (dynamic alliance) are the same, that is, mathematical model does not exist. Although all resources can be combined into a complete and unified system, such as engineering design, manufacturing and management which have formed some systems, and in those systems, even the automation level of internal information and material processing is very high, they are still like some automated “isolated islands” because of the absence of organic connections and co-ordinations, a scientific solution is always needed for this problem. Therefore, those production and operation management systems are not better than others and even further from the best ones.

Has the ICT sector become the engine of China’s economic growth?

Topic: Sustainable production and consumption I (Chair: Shigemi Kagawa, Kyushu University)
Author: JAMAL KHAN
Co-Authors: Yongming HUANG, Yanan ZHANG, Xiaoli NAN

This study examines the key drivers of the information and communication technology (ICT) sector's growth and the dynamics of its sectoral links in the Chinese economy, about which little is known, by using four updated and harmonized input-output tables for the period 2002-2017. The decomposition analysis shows that the ICT sector’s growth was mainly driven by expansion of export and domestic demand in the 2002-2007 period, and by domestic demand expansion in the 2007-2012 and 2012-2017 periods. Furthermore, causative matrix analysis demonstrates that the ICT sector was consistently externalized throughout the study period, regardless of whether it received limited feedback from non-ICT sectors' final demand in the 2002-2007 and 2012-2017 periods, or substantial feedback in the 2007-2012 period. Finally, linkage analysis reveals that the ICT sector has had profound inter-sectoral linkages with both supply- and demand-side effects in the economy. We conclude that the ICT sector has been the engine of economic growth in China, and that stimulating its growth is a key tool for economic development.

Why should you blame your neighbor? A Multi-Regional Input–Output Analysis of emissions embodied in China’s international trade

Topic:
Author: JAMAL KHAN
Co-Authors: Yongming HUANG, Yanan ZHANG

This paper departs from existing literature by estimating, within the same framework and not separately, emissions transfers of air pollutants (APs) and greenhouse gases (GHG) from its trading partners to China using a Multi-Regional Input-Output model. We analyze both China’s environmental cost relative to its gains from international trade, with a pollution terms-of-trade indicator, and the key drivers of emissions embodied in its net exports, with a spatial-index-decomposition analysis. We obtain three main results. First, from one seventh to one fourth of both APs and GHG emissions in China were due to foreign consumption in 2009. Between 27-39% of GHG and 23-68% of APs of the developed-world consumption-based

emissions occur in China. Second, China has been paying larger environment costs than its trade partners to achieve the same value-added through exports. Third, China's emission intensity has been the major driver of embodied emissions in its net exports, with a lower contribution of the other two factors, trade balance and specialization. The link between climate change and air quality—co-benefits and trade-offs—should be considered jointly in the policy process.

Impact of UK – Japan Comprehensive Economic Partnership Agreement (CEPA): Options for UK and Japan

Topic: IO modeling (Chair: Satoshi Inomata, Institute of Developing Economies, JETRO)
Author: Muhammad Omer KHAN
Co-Authors: Muhammad Aamir KHAN

The policy of trade liberalization has been implemented by number of (developing and developed) countries in form of bilateral, multilateral agreement. It is accepted that incorporation and implementation of free trade policy consequently raise the economic growth in the engaging countries. Likewise, the imposition of free trade policy assists in elimination of external trade constrains, encourage investment and trade. UK has already signed and implemented about 38 trade agreements with 97 countries. In other words, the agreements had been signed with non-EU and EU countries. The paper as whole reveals that UK-Japan Comprehensive Economic Partnership Agreement would primarily work to replace EU-Japan Economic Partnership Agreement after Brexit. Additionally, the agreement aims to tailor mesmerizing gigantic growth in Britain's economy which could be impossible during EU-Japan EPA. Moreover, it is considered that the agreement titled as UK-JAPAN CEPA would essentially assist in provision and inclusion in CPTPP (Comprehensive and Progressive Agreement for Transpacific Partnership). Besides the volume and growth, it is mentioned that the UK-Japan CEPA and EU-Japan EPA has a somehow identical match in ad valorem and non-ad valorem tariff.
In this circumstance, the research concentrates on implication of UK – Japan bilateral free trade agreement along with additional potential scenario of bilateral five percent trade facilitation paired with liberalized trade using computable general equilibrium (CGE) approach. It is to be mentioned here that the analysis uses GTAP dataset 10a. The potential trade facilitation scenario aids to reduce the trade cost established by NTBs. In GTAP model, the constrains and barriers are determined by ad-valorem equivalents (AVEs) and added into GTAP by AMS tool (import augmenting technical change – Armington nest). This shock works as technological shock to galvanize and arouse trade volume and economic variables by improving the trade facilitation scenario. The shock pretending 5% trade facilitation works in reducing the trade cost, trade barriers and constrains by the specific amount calculated as of AVEs. The outcome of UK-Japan CEPA and UK-Japan FTA with trade facilitation would have significant and luminous impact on both economies however, there exist disparity across some of the variables. The
real GDP for both countries have a higher expectancy by implementation of UK- Japan CEPA + trade facilitation (UK grows by $1411M while Japan elevates by $924.5M). Similarly, the term of trade is also higher to ToT from UK – Japan CEPA. However, the real returns from factors reduced for both countries (in total) by UK – Japan CEPA + trade facilitation. Briefly, the fact behind the decrease in return is the excessive presence of factors like land and natural resources. In other words, diversion of productivity from land intensive to labour and limited land.
The results reveals that if both countries step forwards to extend CEPA towards trade facilitation agreement then it would result in win–win scenario for both. Keeping the same tariff concession as proposed by the paper would result in a very luminous and bright outcome.

Changes in income of different household types and the impact on UK consumption-based emissions and climate policy

Topic: Sustainable production and consumption II (Chair: Shuning Chen, Kyushu University)
Author: Lena KILIAN
Co-Authors: Anne OWEN, Andy NEWING, Diana IVANOVA

Higher income is frequently seen as a key driver for higher consumption-based emissions. Despite this, economic emission reduction policies often disproportionately affect lower income households. Thus, understanding the goods and services different types of households consume at different income levels is key to understanding how policy can reduce emissions of those emitting the most. Similarly, understanding how income reductions shape emissions of different household types can be critical. To assess this, we use an environmentally-extended multi-regional input-output analysis to estimate consumption-based greenhouse gas emissions for 4000-6000 UK households annually from 2001-2020. Data used to estimate these come from the UK's multi-regional input-output model and the Living Costs and Food survey, an annual household expenditure survey. We analyse these emissions longitudinally at a product level. Importantly, we look at emissions in a time period with two major income changes: the economic recession in 2007, and the COVID-19 pandemic in 2020. The former reveals how emissions change with income reductions, while the latter shows how emissions change with income uncertainty and government mandated lifestyle changes. This can reveal where emissions decrease because of these changes and where they remain stable or increase. These results can inform policy by showcasing the importance different household types place on different goods and services even after income reductions, uncertainty, and lifestyle changes. For instance, this research can reveal the impact carbon taxes might have on different goods and services, as it shows which goods and services different households types consume less of at lower income levels. This can aid the design of socially just emission reduction policies; knowing how households at different income levels change consumption with income reduction and uncertainty allows for the design of climate policy which targets the reduction of emissions of higher income households and the redistribution of carbon emissions from necessities.

Decomposition of Supply, Demand, Trade and Value Chain Driven Determinants of Structural Change

Topic: Structural Decomposition Analysis (Chair: Jose M. Rueda-Cantuche, European Commission)
Author: Klemen KNEZ

We address the question of long-term structural changes in intersectoral employment. The two main research questions are: What are the country specific supply-driven, demand-driven, trade-driven and value-chain-driven determinants of long-term employment changes (1.) from manufacturing to services and (2.) from agriculture to the rest of the economy. We conduct a comprehensive multiregional input-output analysis using structural decomposition. We decompose annual employment changes in each country-sector into real changes in the labour productivity, real changes in the structure of supplier linkages, fabrication effects, and real changes in final demand. To solve the problem of the dependence between the value-added coefficients and the Leontief inverse, we use the solution proposed by Dietzenbacher and Los (2000) and generalise it to the multiregional level. This leads to the following decomposition: real changes in the structure of domestic supplier linkages, real changes in the structure of domestic import supplier linkages, real changes in the domestic intermediate import propensity, and real changes in the structure of all foreign supplier linkages. We also undertake a separate

decomposition of domestic and foreign fabrication effects and a detailed decomposition of domestic and foreign final demand effects. Using WIOD, WIOD in previous year prices, and SEA, we undertake a separate structural decomposition of employment changes for each of the 43 available countries. We construct two indices of structural change by summing the changes in employment from manufacturing to services and from agriculture to the rest of the economy over the entire period to identify a unique set of determinants of structural change for each country as well as for the world. The main novelty of the study is the systematic consideration of separate domestic and foreign real changes in supplier linkages and fabrication changes on the dynamics of structural change, which sheds new light on the country-specific determinants of structural change.

The role of foreign labour employment in emerging economic sustainability: A comparative input-output analysis

Topic: Employment analysis (Chair: Rodrigo Emmanuel Santana Borges, Complutense Univesity of Madrid)
Author: Bawani LELCHUMANAN
Co-Authors: Mohd Nasir Nasir MOHD SAUKANI, Noorasiah SULAIMAN

Employment as one of the economic policy instruments is regarded as a significant contribution to all industries of an economy. The perception of employability is crucial for an emerging economy measure. Foreign labour is concentrated in doing temporary work, and in response to continued economic advancement and demographic changes, Malaysia is experiencing an increase in foreign labour. Policy-makers face pressure to improve the labour market information and economic growth. In this analysis, comparing Malaysia's Input-Output Tables for the 2005, 2010 and 2015 period, we disaggregate two major labour groups, local and foreign, into nine occupation levels. These occupation levels are aggregated into three types of skills: skilled, semi-skilled, and low-skilled. The labour market disaggregation is treated as exogenous. By determining the employment multiplier, employment-inducing effect and stability of employment multiplier for all sectors, these models effectively estimate the contribution of the foreign labour employment and delve into the evolution of the Malaysian industrial structure. The analysis reveals higher complementary among foreign and local, especially in low skills to utilise the labour-intensive sectors. Results suggest prevailing positive effects on the Malaysian economy when employing foreign labour. However, the importance of low-skilled foreign labour is connected with higher productivity in the country's labour-intensive sectors, especially in plantation, construction and services subsectors. The stability evaluation of the employment multiplier suggests that the labour market sustainability can be, to a certain extent, shaping the job market, also be related to slower technological changes among the sectors in Malaysia.

Keywords: Input-Output analysis, employment, multipliers, emerging economy, sustainability

Measuring the economic contribution of firms and activities in terms of national income

Topic:
Author: Oscar LEMMERS

Translating production into value added is well known. Part of that value added will flow abroad. Directly, e.g., because foreign owned multinationals transfer profits to the parent abroad. Indirectly, e.g., because an SME pays interest to a bank that uses it to pay divided to foreign stockholders. How much national income is generated by industries, types of firms (non-multinational, domestic multinational, foreign multinational) and different types final expenditure?

We illustrate our method with data for the Netherlands, 2015. First, we compile an input-output table where each industry is split by type of multinational. We use the existing input-output table, microdata about production, value added, international trade and a multinational indicator. Then we compile a flow of funds table, using a mix of macro and micro data to split the income flows in the Dutch Sectoral Accounts. It shows income flows between each type of multinational in each industry, several sectors and rest-of-world. This allows for estimates at detailed level (for example, by industry, by type of enterprise, by type of final expenditure) how much of the value added flows abroad.

A novelty is that the indirect flow abroad is captured. E.g., when a manufacturer pays interest to a bank that uses it to pay dividends to a foreign entity. Other papers consider various types of income (e.g., interest, dividends, re-invested earnings) flowing abroad or various types of firms (e.g., multinationals and non-multinationals). To our knowledge, this paper is the first to do both.

Key messages: a substantial part of value added flows abroad. A sizeable part, also value added of domestically owned firms, first flows to a domestic entity and only then leaves the country. There are substantial differences between industries and types of firms.

Handbook of extended supply and use tables & practical applications

Topic: Handbook on Extended Supply and Use Tables I (Chair: Jose M. Rueda-Cantuche, European Commission)
Author: Oscar LEMMERS

This is an abstract for the proposed special session "Handbook of extended supply and use tables"

It is well-known that heterogeneity in industries in supply and use tables and subsequently in input-output tables exists and that it might it distort analysis. For example, SMEs and large enterprises, multinationals and non-multinationals have different import and export patterns. Introducing this heterogeneity in the data would, among others, improve the quality of existing tables due to the increased granularity, improve TiVA indicators such as imports embodied in exports of an industry and create new policy-relevant indicators. After all, nowadays policies are not only at industry level, but also for different types of enterprises.

Over the years, both the OECD and several countries developed new methods and data.

However, these works are scattered and not all of them are well-known. There was not yet a text that collected these new works, addressed all issues and made the experiences accessible for national statistical institutes or researchers that would like to use them. Therefore, the OECD expert group on extended supply-use tables decided to develop a handbook describing existing knowledge, practical issues and hands-on solutions.

We will elaborate on the motivation for the handbook and present its general structure. This structure is illustrated with the data and results for the Netherlands. In several projects Statistics Netherlands developed extended supply and use tables / extended input-output table with a size class dimension in industries. It was achieved by using existing tables from National Accounts (consistent with GDP) and detailing them using microdata from structural business statistics and trade statistics. The country experiences of these projects will be shared – the good, the bad and the ugly.

Functional Specialization in Global Supply Chains and the Environmental Performance of Countries

Topic: Consumption-based accounting (Chair: Bart Los, University of Groningen)
Author: Bart LOS
Co-Authors: Xianjia YE

The rapid proliferation of Global Supply Chains (GSCs) has led to a kind of trade specialization that goes beyond specialization in industries. Countries now specialize in performing business functions (also within industries), which makes fair comparisons of the performance of industries across countries complicated. One of such comparisons relate to their environmental performance. In this paper, input-output techniques and regression analyses are used to find relationships between the types of business function into which countries and industries therein have specialized and their CO2-emissions per dollar of value added. The analyses relate to the period 1999-2008, when GSCs became pervasive. The data are for 40 countries and 35 industries. The input-output tables and emission data are taken from the World Input-Output Database and the business function data from Timmer, Miroudot and De Vries (Journal of Economic Geography, 2019). We provide accounts of the extent to which trade-induced specialization in functions affect the emission performance of countries and find that trade-induced functional specialization implies that trade affects the environmental p[erformance of countries much more than in studies focusing on trade-induced industry specialization. This finding could have implications for studies into the Environmental Kuznets Curve and the Pollution Haven Hypothesis.

A marginal extraction analysis for low-carbon global supply chains.

Topic: Input-output analysis for policy making (Chair: Jing Meng, University College London)
Author: Keitaro MAENO

For climate change mitigation, industries need to establish green supply chains through an effective restructuring strategy. To identify effects of restructuring of the relevant global supply chains (GSCs) on the CO2 emissions at globe, I propose a new input-output framework with a focus on marginal restructuring of GSCs of a particular industry. Based on the latest world input-output database (WIOD) in 2014, I firstly estimate the global CO2 emissions from the GSCs of the particular sector (automobile sector in Japan, Germany and United States in this study). Secondly, I apply the expanded hypothetical extraction method, called the marginal extraction

method (MEM) to the WIOD. The proposed MEM can describe the hypothetical GSC structure in which a unit of a trade coefficient (one percent in this study) of a relevant industry in a relevant country is extracted and substituted by the same industries in other countries (i.e., the marginal restructuring of the relevant GSC). Thirdly, I compare between the global CO2 emissions from the actual and restructured automobile GSCs and estimate the impacts of the marginal restructuring of the GSCs. The results show that the marginal restructuring of Chinese manufacturing sectors of Electrical equipment and Basic metals had a significant CO2 reduction effect in the Japanese automobile GSC. The case studies of Germany and US show that the Russian basic metals sector and the Chinese machinery and equipment sector are the key sectors to reduce the CO2 emissions through GSC restructuring, respectively. Based on the results, I discuss practical trade policies for CO2 mitigation through GSC restructuring and finally conclude that the MEM can help policy makers to design effective climate policies for green restructuring of GSCs.

The economic impact of a tourist tax in Andalusia examined through a price effect model

Topic: Social accounting matrix and its applications (Chair: Keisuke Nansai, National Institute for Environmental Studies, Japan)
Author: Paula Villegas MARTOS
Co-Authors: Manuel A. CARDENETE, María C. DELGADO

ABSTRACT

The tourism industry is a key sector in the Andalusian economy; it accounts for 13% of the regional GDP and 14% of the employment. In 2019, 32.5 million tourists visited Andalusia, and the tourism sector generated 22.6 billion euros. In 2020, the year in which COVID-19 paralyzed the world, 13.4 million tourists visited Andalusia, which translated into 8,500 million euros of income. After this decrease in tourism in 2020, the total number of tourists for the year 2021 was 20 million, and the forecast for the year 22 is 28 million tourists. The tourism in this region offers employment, wealth and opportunities to many people who want to start a business in Andalusia. In this context, we wonder if the imposition of a tourist tax would be a benefit or a detriment to the region.

This article analyzes how to use a social accounting matrix (SAM) to empirically study the effects of such a price burden on the regional economy of Andalusia. The methodology that we use consists of a specific model of price effects, which analyzes the impact of introducing a tourist tax in Andalusia. The database used in the analysis is the Andalusian SAM, which was built using data from 2016. This study will enable us to better understand and reflect on the existing structural interdependence between the productive sectors and to evaluate the implicit weights and price elasticities of different tourist items.

Keywords: Input–Output Analysis, Applied General Equilibrium, Social Accounting Matrix, Price Effects Model, Tourism, Andalusia.

JEL Classification: C67, C68, D57, D58, E37, R13

Time Series Datasets of the Embodied Energy and Emission Intensity Data for Japan Using Input-Output Tables

Topic: Structural Decomposition Analysis (Chair: Bart Los, University of Groningen)
Author: Sora MATSUSHIMA
Co-Authors: Shigemi KAGAWA, Keisuke NANSAI, Jinjun XUE

The 3EID database (i.e., Embodied Energy and Emission Intensity Data for Japan Using Input-Output Tables) provided by the National Institute for Environmental Studies of Japan has been widely used in many hybrid LCA studies. Although researchers can use the embodied sectoral CO2 emission intensities in t-CO2 per million JPY in different years (e.g., 2005, 2011, and 2015) from the 3EID database, it is meaningless to evaluate temporal changes in the embodied CO2 emission intensities. In doing it, we firstly need to estimate input-output tables in constant prices using survey or non-survey method. Secondly, the embodied CO2 emission intensities at sector level are calculated by multiplying direct CO2 emission intensities vector by Leontief inverse matrix in constant prices. This study estimates time series input-output tables (IOTs) with 368 commodity sectors for 2005, 2011, and 2015 using double deflation (DD) method as a survey method and GRAS method as a non-survey method and provides time series datasets of embodied sectoral CO2 emission intensities in constant prices (i.e., 2015 prices). It is important to note that the DD method employed in the statistical bureau of Japan implicitly assumes sectoral price homogeneity in the sense that intermediate and final demand of a particular sector are deflated at a single price index. On the other hand, the GRAS method allows us to deflate intermediate and final demand of a particular sector at different price indexes. A comparison in the embodied CO2 emission intensities in constant prices estimated by using the DD and GRAS approaches shows that the price homogeneity assumption in the DD approach brought about an underestimation of the embodied CO2 emission intensities in many sectors. Looking at aggregated industry groups, the price homogeneity assumption caused significant fluctuations in the embodied CO2 emission intensities in nonferrous metals sector. We suggest that physical input-output data of those sectors with higher uncertainty identified in this study should be incorporated into a mixed-units input-output approach and then structural decomposition analysis should be conducted.

An Integrated Input-Output Based Method of Multifactor Productivity Measurement

Topic: Productivity and efficiency analysis I (Chair: Douglas S. Meade, Inforum)
Author: Douglas S. MEADE

An Integrated Input-Output Based Method of Multifactor Productivity Measurement
Douglas S. Meade
Abstract

In the United States, the Bureau of Labor Statistics (BLS) compiles multifactor productivity (MFP) measures of output per unit of combined inputs for the private business, private non-farm business, and manufacturing sectors, and for 18 NAICS 3-digit manufacturing industries. The Bureau of Economic Analysis (BEA) has been producing components of a KLEMS database at a level of about 65 industries for several years. In the Inforum LIFT Model, we have adopted the BEA classification for the industry sectoring, and have built a block of the model in which MFP can be calculated both historically and in the forecast. The data on which the LIFT MFP modules is based are internally consistent, and relate to the IO database used to build the model. The model

can also yield an economy-wide aggregate MFP estimate.

Estimates based on the neoclassical approach to MFP measurement were presented in an earlier paper. In the current paper, we adopt a method that has been explored by Statistics Canada, that involves calculating the MFP related to the provision of each commodity of final demand. This method uses IO calculations to resolve productivity into the direct and indirect use of primary factors to produce each unit of final demand. We apply this technique to the U.S. model database described above, to obtain alternative measures of MFP growth by commodity for the U.S. for the period 1997 to 2020.

The narrowing gap in carbon emission intensities and its effect on global carbon emissions

Topic: How the rising of emerging economies can reshape the world? I (Chair: Jing Meng, University College London)
Author: Jing MENG

International trade affects CO2 emissions by redistributing the production activities to places, where the emission intensities are different from the place of consumption. This study focuses on the net emission change, as the result of the gap in emission intensities between the exporter and importer. Here we show that the relocation of production activities from the global North to the South in the early 2000s led to an increase in global emissions due to the higher emission intensities in China and India. The net emissions related to is about one-third of the total emissions embodied in South-North trade. The narrowing emission intensities between South-North and the changing trade pattern result in declining net emissions. The comparable emission intensities in global South alleviate the concerns that the increasing South-South trade would lead to increased carbon leakage and carbon emissions. The mitigation opportunity to green the supply chain lies in the sector such as electricity, mineral products and chemical products, by approaches such as Carbon Border Adjustment Mechanism, but calls for a universal assessment of emission intensities.

Multinational groups in the Belgian economy: An investigation with extended input-output tables

Topic: Handbook on Extended Supply and Use Tables I (Chair: Jose M. Rueda-Cantuche, European Commission)
Author: Bernhard MICHEL

Increasingly fragmented and global value chains have fostered the development of within-industry patterns of specialisation that are related to firm characteristics such as size, ownership or exporter status. Therefore, an increasing number of countries has started to produce extended input-output that take such heterogeneity into account by disaggregating industries according to at least one of these firm characteristics. We have developed extended IOT with a distinction of firms by ownership category for Belgium for the year 2015. In this paper, we present the statistical methodology and the data used for this disaggregation as well as analytical results derived from the extended tables.
Using data on participation links from different national sources with an extensive coverage, we identify group structures based on control and classify firms into three categories: firms that are completely independent or part of a domestic group, firms that are part of a

domestically-controlled multinational group, and firms that are part of a foreign-controlled multinational group. Based on this classification of firms, we derive an extended IOT using all individual firm-level data sources that serve for the construction of the country's conventional IOT.
From an analytical perspective, we determine the contributions of the three categories of firms to GDP and employment in Belgium, and identify differences in cost structures, import propensity and export orientation between the three types of firms. Through the calculation of linkages, we are able to show that firms that are part of a multinational group are relatively less integrated into domestic value chains. However, integration into the GMRIO table from FIGARO allows to show that they play an important role in Belgium's participation in global value chains. Finally, we also test for sensitivity of results with respect with respect to a lower participation threshold (10% and 50%) and the exclusion of indirect ownership links.

Empirical Analysis of Carbon Footprint Considering Production Activities of Informal Sector

Topic: Regional input-output modeling II (Chair: Vishnu Prabhu, Gokhale Institute of Politics and Economics)
Author: Haruka MITOMA

This study attempts to estimate how informal sector in India contributed to production- and consumption-based CO2 emissions in India. The informal sector is a set of activities that are imperfectly regulated by the government and it is hardly accounted on official statistics. In India, the third largest CO2 emitter in the world following China and the U.S., production activities of the informal sector accounts for about half of the GDP and employs about 90% of the population. In spite of the huge size of the informal economy, due to the unavailability of economic and emission accounts, it is not well identified how the production activity of the informal sector involves CO2 emissions in the whole supply chains in India. We first constructed an environmentally-extended input-output table in 2016 in India that distinguishes between formal and informal manufacturing activities in India by using the official data published by the Indian government and previous studies. We visualized the environmentally-important supply chains with higher CO2 emissions as networks. Our results showed the several informal sector is included in the supply chain which induced the largest CO2 emission in India and especially the informal sector in non-metallic mineral products contributed to huge CO2 emissions. The impact of informal sector in CO2 emission is not negligible and it is necessary to address the informal sector for a rapid reduction of CO2 emissions in India.

Dimension and formalization impacts of Rio de Janeiro's Shadow Economy: an input-output based method design and insights from real data

Topic: Regional input-output modeling I (Chair: Everlam Montibeler, The Federal Rural University of Rio de Janeiro)
Author: Everlam E. MONTIBELER
Co-Authors: Filipe Vasconcelos ROCHA, Rodrigo Emmanuel SANTANA BORGES

The phenomenon known as "Underground Economy" occurs when economic activities are carried out outside official statistics, comprising both legal and illegal activities. The illegal economy, despite generating employment and income, is responsible for financing criminal activities

harmful to society. One of the main consequences of the shadow economy is the distortion of the evaluation of the economy as a whole, the affectation of public policies and economic planning. The Multiple Indicators and Multiple Causes model (MIMIC), which is a specific case of structural equation models, is the most used in GDP estimation. The paper contributes for new methodological for estimation the size and impacts of shadow economic activities using an input-output based methodology and data for Rio de Janeiro. We propose to combine Brazil's National Household Survey's and inter-regional input-output data to disaggregate informal activities already included in official estimates, based on further assumptions regarding output-to-employment and wages-to-employment ratios in both formal and shadow activities, and RAS balancing techniques. This is akin to the 'labour approach' to informal economy, but taking full advantage of regional accounts and national survey data. After isolating each shadow economic activity by sector and application of the Input–Output Structural Decomposition Analysis we are able to approach hidden production and employment underestimation of the real dimension of Rio's shadow economy, and simulate possible impacts of partial formalization of such activities.

Contemporary world market, values and depreciation: insights from the World Labour Values Database

Topic: Employment analysis (Chair: Rodrigo Emmanuel Santana Borges, Complutense Univesity of Madrid)
Author: Everlam E. MONTIBELER
Co-Authors: Rodrigo Straessli Pinto FRANKLIN, Everlam E. MONTIBELER, César SáNCHEZ

The contemporary world market is marked by a strong integration of productive capital under the command of transnational companies. Such integration and the advancement of productive forces led to much broader and more detailed estimates from a sectoral point of view and for a vast number of countries. At the same time, based on the work of Piero Sraffa, the debate on prices and values was reignited, which involved ways of empirically approaching the consumption of fixed capital, or depreciation. The present article focuses on taking advantage of the information and results recently made public in the panel and World Labour Values Database (WLVD) to reflect on its concrete impact, in the deviations of prices from estimated values, as recorded for near two decades, between 1995 and 2009. After a critical dialogue from a theoretical point of view, a brief exposition about the WLVD is made, a proposal is outlined to analyze the effect of considering or disregarding the consumption of fixed capital in the estimation of values

and in its difference with the prevailing market prices. After analyzing results in both dimensions, final remarks are added to stress possible future research on the topic and of the limits of current methods, regarding extensions for when no data on capital stocks and depreciation is available.

Real disaggregate multipliers in different approaches: the Mexican case

Topic: Classical IO applications (Chair: Eduardo Moreno Reyes, University of Macerata)
Author: Eduardo MORENO REYES
Co-Authors: Maurizio CIASCHINI, Rosita PRETAROLI, Stefano DERIU, Claudio SOCCI

Abstract

The aim of this paper is to analyze and compare the multiplier effects of three different multisectoral models: open classical model by Leontief (1944) or short model; Miyazawa model (1976) or elongated model, which endogenizes the primary allocation of income and the final consumption; Ciaschini & Socci model (2006) or extended model, which considers as endogenous also the secondary income distribution and investment (optional choose). The elongated and extended models' structural matrices can be decomposed in the Leontief multipliers matrix and the matrix which contains the inducted total effects, that is the income multipliers. Moreover, the Macro Multiplier approach (Ciaschini & Socci, 2007) isolates all feasible structures of multipliers and permits the identification of the latent structure of exogenous final demand able to maximize the total multiplicative effects on production and income.

The extended approach offers a detailed description of the direct, indirect, and induced effects of an exogenous shock, helping the policy makers in designing policy measures aimed to the income maximization. In addition, by analyzing the Macro Multipliers on income multiplier matrix, it is possible to quantify not only the effects on the intermediate demand but also the impact on all the other phases of the income generation and distribution.

The three different models are developed for the Mexican economy on the base of the Social Accounting Matrix. The results of the analysis confirm that the more meticulous construction of income multipliers in the extended model, fit better with the structure of macro aggregates. Indeed, the industries with the highest multiplier impact correspond to those in which the Mexican households expend the 70% of the disposable income, as reported by the national surveys of household income expenditure. Thus, this correction becomes fundamental if the aim of the research is designing a policy with the highest multiplicative effects.

Carbon Footprint Analysis Based on the Structural Position in the Global Supply-Chain Networks

Topic: Input-output and the network theory II (Chair: Fumiya Nagashima, Kindai University)
Author: Fumiya NAGASHIMA
Co-Authors: Shohei TOKITO, Tesshu HANAKA

For developing fair and effective policies to mitigate climate change, it is important to understand the characteristics of sectors constituting the global supply chain network and implement policies that consider these characteristics. Production, consumption, and betweenness-based emissions identify the large emitters, the larger final consumers indirectly contributing to larger emissions, and critical transmitters, respectively. However, the three emission accounting methods are independent and have distinct criteria, and cannot compare the specific characteristics each sector has. Focusing on the structural position of sectors in the global supply chains, this study develops the attribution analysis framework for inter-sector transactions which allows us to reveal the characteristics of sectors and transactions and visualize their interconnections within the

complex supply chain network. We also apply the attribution analysis of each sector and transaction to a multi-regional IO table and clarify emission attributions of key sectors and transactions to elucidate the best strategies for CO2 emission reduction in the global supply chain. Our results show that the transaction from the Chinese basic iron to the Chinese fabricated metal production has production-oriented characteristics and would reduce CO2 emission effectively through the adoption of renewable energies in the Chinese basic iron sector. Furthermore, the transaction from the Chinese basic iron sector to the Chinese motor vehicle sector would require the Chinese construction sector to reduce its life-cycle CO2 by changing its input structure. Our analytical framework thus proposes specific policies that could effectively reduce specific sectors and transactions' carbon footprint.

Constructing interregional input-output tables for Negeri Sembilan Malaysia for assessing sources of economic leakages

Topic: Employment analysis (Chair: Rodrigo Emmanuel Santana Borges, Complutense Univesity of Madrid)
Author: Nurul Sakinah NGAINI
Co-Authors: MUHAMMAD ANAS NABIL AL-FATTAH MUHAMMAD YAZID, Muhammad Daaniyall ABD RAHMAN, M. Yusof SAARI

Over the last three decades, Malaysia has been suffering from 'middle-income trap', among others, due to an unbalanced regional growth. The rapid growth of some industrialized states due to bias development policy has exacerbated the regional unbalanced problem, leaving economic and social disparity to be hardly resolved. This situation occurs due to absence of a regional planning database to measure the impact and linkages of economic sector at the regional level. At the national level practices, input-output tables are widely used for macroeconomic policy making, but at the state level, the use of such database is limited due to data limitation and lack of expertise. In the existing literature, there are few studies attempted to construct regional input-output tables for some states in Malaysia but none for an interregional input-output tables (IRIOT). This study aims to construct an IRIOT for a state in Malaysia, called the Negeri Sembilan. FLQ regionalisation technique is applied to construct the IRIOT, where data are compiled from various sources, such as National Accounts, Economic Census, Household Income and Expenditure Survey, and trade data. The constructed IRIOT consists of 13 main economic sectors with flows of intermediate demand between Negeri Sembilan and rest of the states. Standard input-output analysis such as linkages and multiplier indicators are used to measuring the potential of the economic sectors in the state. Results reveal three important findings. First, the Negeri Sembilan state is highly dependent on other states for its economic inputs and that limits for high-value added production to operate in its territory. Second, six main sectors are identified as strategic sectors with high value-added multiplier and linkages effects. Third, resource-based economic sectors, particularly agricultural sector, become a stronghold for generating income for the state. In sum, these results give a strong signal for a comprehensive economic transformation within the state in order to improve the regional imbalances.

CO2 Mitigation through Similarity Analysis of Production Technologies and Lifestyles of Nations

Topic: Regional input-output modeling II (Chair: Vishnu Prabhu, Gokhale Institute of Politics and Economics)
Author: Waka NISHIFUJI
Co-Authors: Kayoko SHIRONITTA, Haruka MITOMA, Shigemi KAGAWA

□□□To achieve a long-term temperature goal in the Paris Agreement, countries need to efficiently change production technologies and lifestyles toward building a low-carbon society. However, since the production technologies and lifestyles differ from country to country, it is necessary for the government to set a possible CO2 reduction target for 2030 through effective policies implemented by benchmark countries.
□□□We use the EXIOBASE3 multiregional input-output table of 44 countries and regions and calculate a similarity matrix for technical coefficients between countries as well as a similarity matrix for household consumption coefficients between countries.
□□□The Ward method as a hierarchical clustering approach is applied to the similarity matrices for production technology and consumption.
□□□From the results, we find that the countries are classified into several clusters including (i) developed countries including G7 countries, (ii) developing countries (e.g., the BRICS), (iii) countries with higher consumptions of certain consumption items such as health and social work services and real estate services (e.g., the US and Switzerland), and (iv) countries where the item of hotel and restaurant services accounts for a larger share of household consumption (e.g., Spain and Austria).
□□□We further investigate household carbon footprints for each group and find that there exists a significant gap in the average carbon footprints of countries that belong to the cluster. We suggest that a country can reduce CO2 emissions through learning from the benchmark countries with similar production technologies and lifestyles founded in this study.

Economic and Environmental Consequences of the COVID-19 Pandemic through Foreign Tourists Demand in Japan.

Topic: Regional IO analysis (Chair: Shigemi Kagawa, Kyushu University)
Author: Yusuke OGA
Co-Authors: Shigemi KAGAWA, Tomoaki YOSHIZAWA

Foreign tourists demand was one trillion (JPY) in 2012 in Japan and thus it has considerably contributed to the Japanese economy. The government estimated that the foreign tourists demand will increase by a factor of 15 from 2012 to 2030. However, the COVID-19 pandemic has contributed to rapidly shrinking the inbound demand since December 2019. On the other hand, it is true that the slowdown of economic activity due to the COVID-19 pandemic reduced CO2 emissions in 2020 and it contributed to climate change mitigation. To the best of our knowledge, the economic loss and the environmental benefits in a country are still poorly understood. In doing it, we propose an environmentally-extended, semi-closed input-output model that incorporates endogenous final consumptions of a nation as well as exogenous final consumptions of the foreign tourists. Based on the analysis framework, we found that the COVID-19 pandemic led to the economic loss of 1260 billion yen and the emission reduction of 16,517 kt-CO2 in 2020 in Japan. Tourism and restaurant business activities had the biggest direct economic loss, whereas they indirectly contributed to considerably reducing CO2 through reducing electricity demand. This study suggests a counter-measure against COVID-19 pandemic. The government

should not only give financial support to higher priority industries (i.e., heavily-damaged industries) identified in this study but require them submit a report on how their production activity environmentally improves through the financial support.

The relationship between the international-openness along with the industrial network and economic activity of each country

Topic:
Author: Shunsuke OKAMOTO
Co-Authors: Kayoko SHIRONITTA

Nowadays, many studies about international trade and economic activity have contributed to the understanding of globalization. Studies about the relationship between economic activity and trade openness tend to treat a country as a unit of economic activity. On the other hand, Input-Output table, which enable us to consider the world-wide supply-chain, offers us features of many kinds of industry. When we mix the IO table and long-term viewpoint, we can get close to the nature about the effect of international trade on our economy.

The method used in the research is regression analysis. As the explanatory variable, we calculate an indicator which can measure how internationally-widely the industrial networks are extended, employing IO table. In order to define it, we use the sum of domestic transactions through the entire supply-chain and the sum of domestic and international transactions through the entire supply-chain.

The data used in the research is Long-run World Input-Output Database: Version 1.1. The data includes the industrial transactions among 23 industries of 25 countries from 1965 to 2000.

The original contribution of this research is we present evidence that the faster the international trade progresses with globalization, the wealthier each country gets.

The medium-high and high-intensity technology sectors in Mexico and Brazil: a structural decomposition analysis between 2000-2014

Topic: Classical IO applications (Chair: Bernhard Michel, Federal Planning Bureau of Belgium)
Author: Patieene Alves PASSONI

We develop a structural decomposition analysis (SDA) to identify the importance of manufacturing and services with mid-high and high technological intensity (MH&HT) to the changes in gross output for Brazil and Mexico between 2000 and 2014. We break down the output changes in the composition and level of final demand, the production technique (technical coefficients), and the trade pattern (share of imports in the total supply of inputs and final goods). We use the World Input-Output Tables and the OCDE technological intensity classification data. The results show that the importance of the MH&HT group tends to be pro-cyclical in the two economies, increasing during periods of more remarkable economic growth (2000-2008 for Brazil and 2010-2014 for Mexico). This relation tends to be perceived for manufacturing and less so for services. Also, the increase in the proportion of imported inputs and final goods contributes to reducing the relevance of the MH&HT group.

Trade between EU countries and the world: Deviations in official inter-country input-output tables and their implications for policy

Topic: Input-output impact analysis (Chair: Keiichiro Kanemoto, Research Institute for Humanity and Nature)
Author: Pablo PINERO
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During the last two decades, research teams and institutions across the world conducted various pilot projects for compiling world coverage inter-country input-output (ICIO) databases. WIOD, Exiobase, GTAP or Eora were outcomes of this process. These new databases allowed performing a wide range of innovative and far-reaching socio-economic and environmental assessments on the impacts of international trade. However, since these were experimental attempts, which followed different assumptions and addressed dissimilar research questions, deviations among them are frequent and noticeable. We are now in a new stage, in which multilateral institutions, such as the OECD and Eurostat, committed to provide official ICIO databases on regular basis, which are or aim to be, fully consistent with official national input-output data and economic macro-aggregates. In this task, the European Union (EU) brings a particular challenge, because of imports and exports matrices, which require that EU trade flows are disaggregated based on assumptions and auxiliary data into intra- and inter-regional fractions. In this paper, we assessed deviations in trade between two officially sponsored databases: the latest OECD's and Eurostat's ICIO tables, both released in 2021. We first compared imports and exports by country and sector for the years available in both databases, i.e. 2010-2018. Second, we estimated indicators on trade in value added, employment and carbon ('embodied') to evaluate the potential impact of the discrepancies on policy monitoring systems. The article closes evaluating possible reasons for such differences, and outlining strategies to overcome them in future releases of both databases.

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

Topic: Computable General Equilibrium Modeling and Social Accounting Matrices (Chair: Mun S. Ho, Harvard University)
Author: Radhika PIPLANI

Significant 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.

Macro-economic impacts of Renewable Energy Transition in India: An Input-Output LCA approach

Topic: Energy Input-Output Modeling II (Chair: Lorenzo Rinaldi, Politecnico di Milano)
Author: Vishnu Sivadasa PRABHU
Co-Authors: Kakali MUKHOPADHYAY

India’s higher emphasis on adoption of Green Energy for power generation in recent years is aligned with the twin Sustainable Development Goals (SDG) 2030 of tackling climate change (SDG 13) and ensuring sustainable, affordable, reliable, and modern energy to all (Goal 7). This study intends to evaluate the economy wide impact of India’s ambitious 280 GW solar and 140 GW wind capacity expansion programme by 2030 using a hybrid Input Output model. It is used to estimate the consequential LCA impact for solar and wind energy across the economy. The environmental dimension – air, water and solid waste treatment is endogenized in the hybrid Input-Output model such that the pollution abatement cost is fed back into the economy. Preliminary findings provide interesting results. The impact total output on wind industry (0.84%) is higher than the solar PV industry (0.04%) and capital-intensive sectors such as iron and steel, chemicals and petroleum products benefit the most. However, the economic impact in terms of GDP and employment is minimal since the RE industry is at a very nascent stage in its development. Furthermore, environmental burden of solar PV and wind turbine waste of approximately 2.9 million tonnes (MT) and 18.5 MT, respectively are primarily from heavy metals such as zinc, chromium, iron and lead which will create huge abatement cost and simultaneously provide an opportunity to engage the circular economy potential at end-of-life phase. Proceeding with the RES capacity expansion, without accounting for the impending waste accumulation will make India drift further away from its clean energy targets. The substantial savings in emissions and material resources from transition towards RE sources and circular economy approach can serve as a catalyst in helping India achieve its decarbonization targets under the COP26 accord and SDGs simultaneously.

Tax elimination on terminal handling charges of the sectoral importers: assessing the economic effects in Brazil

Topic: Computable General Equilibrium Modeling and Social Accounting Matrices I (Chair: Stefano Deriu, University of Macerata)
Author: Andressa Lemes PROQUE
Co-Authors: Admir Antonio BETARELLI JUNIOR, Edson Paulo DOMINGUES, Weslem Rodrigues FARIA, Aline Souza MAGALHãES

In Brazil, the terminal handling charges (THC) at destination for import cargo occurs between the unloading of the goods in the national territory and the customs clearance. This rate inflates the customs value of imported products and the basis for charging all imports on Brazilian imports. Incompatible with the rules of the World Trade Organization (WTO), this practice distorts the competitive trends of Brazilian sectors in the domestic and foreign markets, whose concern is recurrent of the Brazilian commercial policy. Our study contributes to this debate in course and analyzes the economic impacts of THC in the calculation basis for the incidence of taxes. We estimated the annual average THC and simulate their removal in Brazilian import values from a SAM and R&D based computable general equilibrium (CGE) model. With policy change, the main findings indicate the Brazilian economy would become more industrialized and with greater technological intensity in the long run. Investment in physical capital and R&D would grow, while the export and foreign trade agenda would become more diversified in manufactured goods,

even with the greater penetration of
imports. The expansion of the private sector would ease future dependence on the public sector in the generation of knowledge and physical capital.

Keywords: Tax policy; Imports; Brazilian ports; Economic Impacts; dynamic CGE model.
JEL Code: C68; H25; R40; R48.

Fuel tax, Cross Subsidy and Transport: Assessing the Effects on Income and Consumption Distribution in Brazil

Topic:
Author: Andressa Lemes PROQUE
Co-Authors: Admir Antonio BETARELLI JUNIOR, Fernando Salgueiro PEROBELLI

Passenger transport has become a typical item in the household budget in Brazil, and structural changes in this type of service affect households differently. Our paper explores the links between consumption, income and transport in assessing the redistributive and economic effects of the fuel tax in the Brazilian economy, called contribution of intervention in the economic domain (CIDE). To accomplish this task, we developed a dynamic computable general equilibrium model that recognizes a Social Accounting Matrix (SAM). Two scenarios are evaluated: (1) an overall cut of CIDE-fuels to assess its role in economy; (2) the burden of the gasoline tax and reduction of the diesel tax to subsidize public transport services. The main findings indicate a deviation from real GDP above the baseline forecast path, positively affected by internal market and the reduction in income inequality. Typical households in the middle- and lower-income bracket would benefit most from these policy instruments.

Keywords: Fuel tax; cross subsidy; dynamic CGE model; household income distribution; economic growth.

JEL Classification: C68; E16; H71; R4.

Economic implications of Mega Trade Agreements on South Asia – A CGE Approach

Topic: Global value chain analysis III (Chair: Carmen Zürcher, OECD)
Author: Zulekha QADEER

Many developing countries have pursued trade liberalization policies to boost their economies. Everyone acknowledges the positive connection between trade liberalization and economic growth; however, mega-trade agreements have economic implications on non-members, especially in developing countries. With this backdrop, this research seeks to quantify the impact of mega-trade agreements such as RCEP, SAFTA, ASEAN, MERCOSUR, TTIP, CPTPP, and APEC on the South Asian economies (Pakistan, India, Bangladesh, and Sri Lanka) using a global computable general equilibrium model. Results show that all South Asian countries will likely suffer due to Trade diversion of those sectors in which they hold a comparative advantage, especially textile and wearing apparel to members of these mega-trade agreements. With India, no more part of RCEP, the highest negative impact on all South Asian countries is of RCEP, TTIP and CPTPP. This research concludes that South Asian countries will be better off economically if

they try to be part of either RCEP or CPTPP trade pacts.

Assessing critical materials demand in global energy transition scenarios based on the Dynamic Extraction and Recycling Input-Output framework (DYNERIO)

Topic: Energy Input-Output Modeling II (Chair: Lorenzo Rinaldi, Politecnico di Milano)
Author: Lorenzo RINALDI
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The energy transition process calls for striving interventions at global level towards the switch to low-carbon and green technologies. Such technologies surely impact positively in the direction of reducing the greenhouse gases emissions; however, their massive deployment brings along intense raw materials exploitation. Some of these materials have already been classified as critical due to their scarce availability: their crucial geopolitical role is then becoming more and more relevant, resulting in several attempts of quantifying the materials impact of energy transition scenarios.

While the majority of the analysed studies adopts purely LCA-based methodologies, this article presents a novel hybrid approach to assess the impact of transition pathways on raw material extraction, which includes both LCA-based and energy modelling features. Such approach has been formalized in a modelling framework named Dynamic Extraction and Recycling Input-Output framework (DYNERIO) and it has been integrated in the open-source platform for input-output analyses handling, MARIO (Multi-functional Analysis of Regions through Input-Output), which the authors contributed to develop. DYNERIO is composed by two soft-linked modules: the first module is an environmentally-extended Multi-Regional Input-Output (MRIO) model, which allows for economic and environmental shock modelling and impact assessment; the second module consists of a linear programming optimization energy model, dedicated to the assessment of regional extraction and recycling of critical materials based on the results of the MRIO model.
Beside the standard environmental and economic impact indicators, such as GDP and CO2 emissions, DYNERIO returns the yearly operating and disposed capacities for energy technologies required to meet the production of exogenously defined final energy services, and the consequent raw materials extraction and recycling.

A simplified case study, based on the Exiobase hybrid-units database (version 3.3.18), is then proposed to demonstrate the framework capabilities. In such case-study, the 2050 energy transition strategy of European Union is analysed, by implementing a set of European announced policies as a technological perturbation in the MRIO module and evaluating their implications in terms of raw material dependence.

Evaluation of the fiscal recovery regime in State of Rio de Janeiro: a CGE analysis

Topic: Methodological aspects of input-output analysis (Chair: Bart Los, University of Groningen)
Author: Filipe Vasconcelos ROCHA

In recent years, the State of Rio de Janeiro (SRJ) has gone through a serious fiscal crisis that forced it to adhere to the Fiscal Recovery Regime (FRR), created by the Federal Government to help States in a serious situation of fiscal imbalance. In 2017, the SRJ joined the FRR and was

required to implement a series of measures, in particular a fiscal adjustment to reduce government investment spending. The work assumes that a fiscal recovery policy that prioritizes government investments is more likely to generate promising results in the state's fiscal results than a policy that only aims to reduce government spending. Using the Computable General Equilibrium (CGE) methodology, the interregional matrix of the population arrangement of the State of Rio de Janeiro developed by The Regional and Urban Economics Lab at the University of Sao Paulo – NEREUS, and the structural lineage developed in the CGE model B-MARIA, an interregional CGE model was developed for the State of Rio de Janeiro and the rest of Brazil, the B-MARIA-RJ (Brazilian Multisectoral And Regional/Interregional Analysis for Rio de Janeiro). The result of the research was a new methodology for evaluating the impact of the Fiscal Recovery Regime on the economy of the SRJ and the rest of Brazil.

Inter-industry linkages influence speed and scope of innovation diffusion in the energy transition

Topic: Energy Input-Output Modeling I (Chair: Kirsten S. Wiebe, SINTEF)
Author: Fabian ROCHA APONTE
Co-Authors: Kirsten S. WIEBE

The energy transition progresses at different speeds globally, with some industries in some countries being at the forefront, while in other industries or entire countries there is hardly any progress. From innovation network analysis we know that innovation activities are highly concentrated among actors that closely collaborate, and technologies diffuse faster in closely connected networks. The Porter Hypothesis additionally links technological progress with strict environmental regulations. Andersen et al., (2020) suggest that a more integrated understanding of the relationship between industrial transformation and sustainability transition is necessary. They identify three issues that require further analysis to enhance the political legitimacy of sustainability transitions: 1) the role of inter-industry linkages, 2) the influence of the current knowledge base, and 3) policy challenges in the multi-sector economy-wide transition process.

Here, we focus on the first two issues and assess the scope and scale of the interlinkage between inter-industry dependencies and the current knowledge base on the speed of the energy transition and, vice-versa, the effect of the energy transition on the industrial structure. The state and speed of the energy transition are measured using the change in CO2 emission intensity by industry over time and the current knowledge base is estimated using the number of innovations in environment-related technologies. Measures of inter-industry connectedness are derived from input-output tables: direct input as well as output coefficients, backward and forward linkages, both intra- and interregional, and inverse-important coefficients.

We empirically test the hypothesis, that environmental innovations depend, among other known factors, such as environmental regulations, also on the technological progress (environmental innovations) in closely connected industries using a panel data model. That is: closely related industries have a similar speed of transition. We differentiate between between-sector spillovers (Jacob spillovers) within and across countries and within-sector spillovers (Marshall-Arrow-Romer spillovers) across countries (Hidalgo, 2021). In addition, we use the above results in a two-stage/instrumental variable approach, where the CO2 emissions at the industry level are the dependent variable as the goal of the energy transition is to decrease GHG emissions from fossil fuel burning. As explanatory variables that determine the level of CO2 emissions, we use inter-industry dependencies in addition to environmental innovations, as well as other local factors, such as access to renewable energy sources.

We use the following OECD databases to obtain an (unbalanced) panel dataset covering the relevant industries in all OECD and some non-OECD countries:
- Innovation in environment-related technologies (1990, 2000, 2005, 2010-2015)
- Environmental policy stringency: (1990-2015)
- Inter-country input-output tables https://oe.cd/icio and its CO2 emission and employment extensions (1995-2018)

Combining the knowledge on how low carbon energy technologies diffuse around the world through inter-industry linkages with data on employment by industry/country, provides empirical data on possible effects of the energy transition on the labour market. Here, both the effect on upstream and downstream jobs as well as emissions can be quantified. This analysis will provide supporting information for the just transition, as e.g. envisioned in the European Green Deal.

Dealing with incomplete data in Extended Supply and Use Tables: various strategies and practical implications

Topic: Handbook on Extended Supply and Use Tables II (Chair: Jose M. Rueda-Cantuche, European Commission)
Author: José M. RUEDA-CANTUCHE
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This work addresses practical situations that often arise when compiling Extended Supply and Use Tables with limited information. We draw lessons learnt from the compilation of the FIGARO Inter-country supply, Use and Input-Output Tables. These situations vary from dealing with inconsistencies (and how to detect them in advance), extending columns using common structures, problems with heterogeneity, potential spread of negative estimates, treatment of negative and sign-shifts, incompatible structures and integration of different source data. Besides, we make a special treatment for n-dimensional generalized RAS cases, involving the application of consistency rules over more than two dimensions. This chapter aims to provide guidelines and various numerical examples to those users or national accountants that compile national Extended Supply and Use tables with limited information.

Resource-based Industries and CO2 Emissions Embedded in Value Chains: a regional analysis for selected countries in Latin America

Topic: Sustainable production and consumption II (Chair: Shuning Chen, Kyushu University)
Author: Eduardo Rodrigues SANGUINET
Co-Authors: Carlos R AZZONI, Augusto Mussi ALVIM

This paper analyses the relative content of CO2 emissions embedded in regional supply chains in four different countries in from Latin America: Brazil, Chile, Colombia and Mexico. We estimate both the value-added (TiVA) and the embedded CO2 incorporated in interregional and international exports, mapping the relative intensity polluting level on value chains. We apply an inter-regional input-output model to determine the interplay between the polluting intensity of resource-based industries and their linkages with the others economic sectors, revealing a map of CO2 emissions to value-added trade in a subnational dimension. The main result reveals an interregional dependence, indicating for resource-based industries, usually intense in pollution, a higher level of embedded CO2 on value-added in each regional economy. This finding has

considerable implications for the sustainable development of these subnational areas.

Circular economy inside the policy structures: a multisectoral approach

Topic: Sustainable production and consumption I (Chair: Shigemi Kagawa, Kyushu University)
Author: Francesca SEVERINI
Co-Authors: Jacopo ZOTTI, Rosita PRETAROLI, Claudio SOCCI

In March 2020 the EU-Commission launched the new Circular Economy Action Plan (CEAP) as one of the main pillars of the European Green Deal, the Europe's new agenda for sustainable growth. The action plan sets a concrete and ambitious program for the EU Member States, which are called to introduce policy measures to minimise waste generation and to increase recycling and materials' reuse. Since these measures are expected to bring both environmental and economic benefits, their evaluation cannot neglect anyone of these two aspects. As for the economic sphere in particular, it is important to distinguish among the implications for the different production activities and for the different Institutional Sectors. On this background, this paper provides a multisectoral analysis of the structure of emissions and waste in Italian economy and identifies a set of policy measures, which are capable to reduce the level of pollution without impinging income growth, thus going beyond the apparent traditional trade-off between environment protection and economic growth. The first result of the paper is an original accounting framework, in which waste generation and air pollution are related to the phases of income generation, distribution and use pictured by the Social Accounting Matrix for Italy. The second is an extended multisectoral model that shapes the connection between the economy and the environment by modelling the processes of production and use of waste and emissions. The third result comes from the application of the Macro Multipliers approach, and it consists in the identification of a set of endogenous demand structures for the policy instruments, which allow achieving the composite policy objective: waste reduction, mitigation of emissions and positive economic performances.

Keywords: Social Accounting Matrix, Environmental Accounts, Circular Economy, Macro Multiplier approach
JEL: C67, E01, E16, Q56.

Bottleneck model for estimation of economic damage of earthquakes

Topic: An Input-Output Analysis for Disaster Damage: A Case Study on the Tokyo Epicentral Earthquake (Chair: Kiyoshi Fujikawa, Aichi Gakuin University)
Author: Mitsuru SHIMODA
Co-Authors: Kiyoshi FUJIKAWA, Takatoshi WATANABE

The Great East Japan Earthquake in 2011 caused damages to auto parts plants in the Tohoku and northern Kanto regions of Japan, which in turn caused parts supply disruptions that halted production at vehicle assembly plants across the country. This phenomenon is caused by the fact that intermediate inputs are at least in the short run completely non-substitutable, and is referred to as the bottleneck effect in this paper. The demand driven model (Leontief model) and supply driven model (Ghosh model) presented in the first presentation cannot handle such phenomena adequately. In this presentation, we introduce a model that emphasizes the idea of complete

non-substitutability among inputs of production, while the demand driven model also assumes non-substitutability among factors. The difference between them is that this idea is used on the demand side of the input good in the demand driven model, while in the bottleneck model the idea is used on the production side. The idea of this model is new and has never been presented at an international conference before, and we believe it is important to introduce this model at IIOA because of its significant academic contribution.
In the Leontief model, the production function can be expressed as the ratio of the quantity of intermediate input goods divided by the input coefficient for each material, the smallest of which is the output. When Tokyo is hit by a disaster, the supply of intermediate input goods from Tokyo to the other region decreases. Since the numerator of each element of the production function becomes smaller, the amount of production will decrease. We estimate the decrease of output of the other region based on Tokyo metropolitan two-regional Input-Output table.
However, the magnitude of the change depends on how Tokyo's output is distributed among industries in other regions. In this presentation, we assume that the distribution ratio is the same as before the earthquake, although this is a strong assumption. Therefore, there is a problem that the bottleneck effect may be too strong in this model.

Factor Decomposition Analysis of Changes in CO2 Emissions from Container Shipping

Topic: Input-output and the network theory I (Chair: Keisuke Nansai, National Institute for Environmental Studies of Japan)
Author: Taiga SHIMOTSUURA
Co-Authors: Shigemi KAGAWA, Tomoaki YOSHIZAWA

CO2 emissions from international shipping were estimated as 1056 million tonnes-CO2, accounting for 3% of the global anthropogenic CO2 emissions and there is an urgent need to decarbonize the sector. To the best of our knowledge, there are few previous studies that attempted to estimate the CO2 emissions from the maritime sector of countries and regions. Based on the microdata of IHS Markit, this study estimated CO2 emissions from container ships owned by major seven operating companies (Maersk, Mediterranean Shipping Company, COSCO SHIPPING, CMA CGM, Hapag-Lloyd, Ocean Network Express, Evergreen) that occupy a large portion of fuel consumptions in maritime transport. Based on the CO2 emissions at company level, we develop a new factor decomposition framework to identify driving forces of the changes in the CO2 emissions from container ships. The results show that (1) CO2 emissions of each company increased by 3.5% on the company average from 2018 to 2019, however Maersk, Mediterranean Shipping Company, Hapag-Lloyd, and Ocean Network Express reduced CO2 emissions during the COVID-19 period (2019-2020); (2) the main reason for this reduction in CO2 emissions of the companies during the COVID-19 period was port calls (i.e., demand-side change factor); (3) the change in CO2 emission intensities in ton-CO2 per ton-miles of container ships (i.e., supply-side change factor) was marginal for all the companies. The environmental and business strategy shown in the sustainability reports provided by the companies has not yet been fully reflected in the major change factors identified in this study. Looking at the marginal contribution of the supply-side factors to CO2 mitigation, the operating companies should put more efforts on improving supply-side factors of size and speed of their vessels to reduce carbon intensity.

The analysis of Carbon dioxide emission structure based on the similarities of economic structure using IO analysis and clustering analysis

Topic: Regional input-output modeling I (Chair: Everlam Montibeler, The Federal Rural University of Rio de Janeiro)
Author: Kayoko SHIRONITTA
Co-Authors: Shigemi KAGAWA, Yasushi KONDO

The international framework for mitigating climate change is moving away from relying on the level of economic development that distinguishes developed and developing countries. For example, the Paris Agreement has launched a climate change mitigation framework in which all countries, independently of developed and developing countries, set their own reduction targets. To achieve the long-term goal of the Paris Agreement, “Holding the increase in the global average temperature to well below2 degree above pre-industrial levels” (UNFCCC, 2016), each country is required to submit the goals, regularly report on the status of their country's efforts, and undergo a review. When review undergoing, it is very important to consider difference of economic structures because the way of the growth of countries is greatly diversifying due to the development of production technology, transportation and communication technology. In this study, we propose a new framework based on the similarity of economic structures. The similarity of the economic structure is estimated from the domestic production structure and consumption structure of the target countries obtained from the World Input-Output Database. The similarity is evaluated as the distance between the matrix of the two countries. Next, the target countries are grouped into several groups by applying a clustering analysis to the similarities. We then discuss how the role of structural similarity played in emitting greenhouse gases around the world. This study proposes a new approach to the existing framework for climate change mitigation and provides important information that can contribute to global sustainable development in the future.

Identifying Environmentally-important Shipping Routes and Ports in the Global Supply-chain Network

Topic: Input-output and the network theory II (Chair: Fumiya Nagashima, Kindai University)
Author: Tomomi SHODA
Co-Authors: Shigemi KAGAWA, Keitaro MAENO, Taiga SHIMOTSUURA, Taiga SHIMOTSUURA

CO2 emissions from transportation sector account for 27% of global CO2 emissions in 2019. In particular, maritime transportation sector accounts for 2% of the global CO2 emissions in that year. Thus, it is crucial to reduce CO2 emissions in this sector for achieving future climate goals. With a rapid increase in demand for maritime transport services through the development of global supply-chain networks, the International Maritime Organization (IMO) has noted that CO2 emissions will continue to grow due to expanding supply-chain networks. Based on the Sea-web Movements Database provided by the IHS Markit Ltd, this study focuses on 8881 container ships owned by shipping companies in 2020 that play an important role in international trade. We estimated energy consumptions of a specific container ship that moves between ports and calculated the energy-related CO2 emissions for a specific shipping route by totalizing CO2 emissions from the movement of container ships. We visualize the CO2 emissions network for more than 44 million shipping routes and identify environmentally-important routes and ports by using network centrality analysis and cluster analysis. The results show that Pasir Panjang (Singapore) and Tokyo (Japan) were identified as key ports in the global supply chains network.

Thus, we suggest that effective CO2 mitigation polices with a focus on the key ports and relevant shipping routes are necessary.

Regional economic impacts of the Brumadinho tailing dam rupture disaster in Minas Gerais (Brazil) based on labor productivity changes

Topic: IO modeling (Chair: Satoshi Inomata, Institute of Developing Economies, JETRO)
Author: Cláudio Eurico Seibert Fernandes da SILVA
Co-Authors: Thais Diniz OLIVEIRA, Rayan WOLF

On 25 January 2019, the Brazilian village of Brumadinho, in the mining-heavy state of Minas Gerais, was taken by the tailings of Córrego do Feijão's dam. This dam rupture is arguably one of the worst human and environmental disasters, leaving over 250 people dead and spreading several ore tailing into Paraopeba River and the surrounding area. The toxic waste of the mine dispersed towards the villages along the Doce River basin and reached the Atlantic coast. As a typical case of negative externalities, this type of disaster leaves behind large-scale environmental and economic damages at local and regional levels. This paper aims to analyze the impact of Brumadinho dam failure in Minas Gerais (Brazil) from a labor productivity perspective. In this sense, it has translated the effects of the disaster into changes in productivity through World Bank estimates. The simulations primarily used Input-Output techniques to assess the economic structure and role of mining. Second, B-MARIA Computable General Equilibrium (CGE) model estimates regional effects as a function of changes in labor productivity. Input-Output Matrix database had obtained using IIOAS methodology, in which the cities directly affected are disaggregated with data referring to the year 2015. The result showed Brumadinho could have an accumulated loss of 1.17% of GDP in up to four years and the other municipalities of 1.81%. There is a loss of competitiveness concerning sectoral activity and exports. The manufacturing sectors are the most affected by the simulations applied. Finally, mining production is relevant to local economy, especially for Brumadinho, so security policies about extractive production are significant so that tragedies like this do not happen again.

A Hybrid Energy Input-Output Table for India: Computing Sectoral Energy Needs and GHG Emissions

Topic: Energy Input-Output Modeling II (Chair: Lorenzo Rinaldi, Politecnico di Milano)
Author: Ganesh SIVAMANI
Co-Authors: Rajesh CHADHA

In this paper, India’s 131-sector Input-Output Table 2015–16 is used to compute the direct and indirect energy consumed and emissions produced by the intermediate production and final-use sectors of the economy through the construction of a 34-sector hybrid Energy Input-Output Table (EIOT). The EIOT contains ten energy sectors: coal and lignite, biomass, crude petroleum, natural gas, combustible petroleum products, non-combustible petroleum products, coal electricity, other thermal (natural gas and petroleum products) electricity, large-scale hydro-electricity, and renewable energy sources & nuclear electricity. Of these ten sectors, three produce emissions when burnt: coal and lignite, biomass, and combustible petroleum products. While the input-output transaction flows are expressed in monetary terms, the flows of energy have been expressed in kilotonnes of oil equivalent (ktoe), and the flows of emissions have been expressed in tonnes of carbon dioxide equivalent (tCO2e). A hybrid unit approach is used by taking the

constructed 34-sector EIOT to compute the Leontief inverse matrix in ktoe and tCO2e terms, which provides the coefficients indicating each sector's direct and indirect energy requirements and emissions per rupee of final demand. The data for this research has been sourced from India's Supply and Use Tables, Energy Statistics, Coal Directory, Petroleum & Natural Gas Statistics, Electricity Statistics, Biennial Update Report and IPCC Guidelines for National Greenhouse Gas Inventories. The results of the emissions analysis show that sectors have embedded emissions from their consumption from upstream industries. When making projections for the future growth of these sectors, these should also be considered. Low-emission technologies in the upstream sectors will reduce indirect emissions from downstream sectors – for example, increasing the share of renewable electricity generation will reduce indirect emissions from electricity-intensive sectors. Policies are needed to reduce emissions by adopting more-efficient production technologies and conserving the use of coal and petroleum products.

The limiting distributions of (country) responsibilities

Topic: IO Theory I (Chair: Umed Temursho, IOpedia and University of Central Asia)
Author: Umed TEMURSHO

This paper starts with exploring the conceptual correspondences of the most salient input-output (IO) responsibility indicators with the well-understood and widely used aggregate economic performance measures. Such approach of simultaneous examination of the circular flows of incomes and of emissions for an open economy clearly demonstrates the uses and limitations of each of the considered IO responsibility measures. As a by-product of this analysis, a disposable income-based accounting as a new responsibility allocation scheme is introduced.

Next, we show that there are two entirely legitimate ways of computing both the consumption- and income-based emissions, whereas the literature discusses and applies only one of such alternative expressions in each case. Here two types of allocation matrices play critical role, which we refer to as "factor to final users allocation matrices" and "factor to primary suppliers allocation matrices". The properties of these matrices are explored in some detail.

Finally, we study the issue of infinite redistribution of responsibilities between final (output) users and primary (input) suppliers, as namely these economic agents ultimately manage and operationalize production units. It is shown analytically that the process of such repeated redistribution of responsibilities is finite. In particular, the limiting or "stationary" distribution of a country's final users responsibility is given by the country gross national expenditure (GNE) share in the world GNE, and that of primary suppliers responsibility equals the country share of gross national income (GNI) in the world GNI. If one does not distinguish the countries of origin of primary suppliers in the value added quadrant of the global multi-regional IO table, the latter limiting distribution equals the proportion of the country gross domestic product (GDP) in world GDP. The implications of the discovered limiting distributions of environmental responsibilities are discussed in the context of international cooperation on climate and in relation to the equitable burden-sharing frameworks widely used by climate scientists.

Tracing the Incidence of Indirect Taxes through the Production-Distribution Chain: Application to Jordan

Topic: Input-output analysis for policy making I (Chair: Francesco Tonini, Polytechnic University of Milan)
Author: Andrey TIMOFEEV

In many counties, the balance of taxation has been shifting from trade taxes towards indirect taxes on domestic consumption, primarily the Value Added Tax (VAT). Policymakers need information regarding who bears the burden of tax changes. In theory, a broad-based VAT should be equivalent to a tax on income after taxes less saving. However, in practice, a VAT never applies to all commodities and sellers uniformly. Thus, the effective tax rate varies among final consumption items depending on the amount of tax levied and credited throughout the production-distribution chain. Furthermore, in addition to the VAT, in some countries, a considerable part of public revenues still derives from excises and customs duties, which in turn become part of the VAT base. In this study, we propose a practical approach to incidence analysis of indirect taxes and apply it to develop a better understanding of the current distribution of indirect taxes in Jordan.

Multifunctional Analysis of Regions through Input-Output (MARIO) for energy transition policies analysis: the case of Italian private passengers' transport sector.

Topic: Input-output analysis for policy making I (Chair: Francesco Tonini, Polytechnic University of Milan)
Author: Francesco - TONINI
Co-Authors: Mohammad Amin TAHAVORI, Nicolò GOLINUCCI, Lorenzo RINALDI, Francesco Davide SANVITO, Enrico ARLANGO, Matteo Vincenzo ROCCO, Emanuela COLOMBO

The global energy sector plays a dominant role in CO2 emissions and it is responsible for almost three-quarters of the total. It is therefore evident that an energy system that does not contemplate a radical transition will not be able to meet future challenges. Europe's objective of pursuing a policy towards a lower carbon energy system was formalized in 2015 with the Paris Agreement. In the most recent years, the commitment was fully embraced with the launch of the Green Deal, an ambitious plan to reduce its emissions by at least 55% by 2030 and to make Europe the first carbon-neutral continent by 2050. The huge technological shift that is forecasted for various sectors to support the transition brings along several risks and threats associated with newly opened supply chains. The complexities of current sustainability challenges, therefore, call for analytical models and tools to properly evaluate transitional policies from a Life Cycle Assessment perspective. The analysis of current existing literature highlights the lack of adequate open-modelling tools that can comprehensively provide a framework to implement transparent, automatic, and easily reproducible shock and footprint analyses for policies and products.
For this reason, Multifunctional Analysis of Regions through Input-Output (MARIO) has been developed and openly published on GitHub. MARIO is a Python package for handling Input-Output (IO) tables and models which aims at providing a simple & intuitive Application Programming Interface for common IO tasks. MARIO supports automatic parsing of different structured tables such as EXIOBASE, EORA, EUROSTAT, and ad-hoc built tables in different formats. Furthermore, MARIO allows for smooth handling of database aggregation, modification, and extension. Finally, ad hoc defined MARIO functions provide IO analysts with a wide set of instruments related to

production or consumption-based visualization of results in different scenarios. As bench test of the newly developed MARIO framework a real case study application for the private passenger transport sector is performed.
Transport sector is one of the main contributors to EU CO2 emissions together with power and industry sectors accounting for 22%, 26%, and 22% of the total 2020 carbon emissions respectively. Part of the reason is attributable to the role played by road transport which, with 820 Mton CO2eq produced annually, is responsible for 72% of the total emissions. Up to 60% of such emissions are related to passenger vehicles alone. To limit private passengers' transport sector emissions, BEV and FCEV technologies are the most promising solutions in substituting internal combustion engine vehicle fleets. BEV and FCEV prospected large-scale deployment makes it necessary to assess the systemic implications, both economic and environmental, arising from the introduction of their respective supply chains. The objective of this application is therefore to analyse in detail the effects of a shift of the traditional car fleet to the new mobility technologies with specific reference to the Italian context. The operational impact of driving the vehicles is assessed together with the respective manufacturing process as well as the infrastructural investments needed to create the conditions for their diffusion. Two scenarios are outlined assuming a 60% penetration of BEVs or FCEVs alternatively in the Italian car fleet.
The adoption of the MARIO framework based on EXIOBASE data allowed an extensive characterization of the interventions considered, outlining in detail the production processes of cars and their main components and making it possible to analyse the implications deriving from the introduction of the new supply chains. The indicators used to quantify the impact of car substitution have been chosen to represent the economic, environmental, and social dimensions. According to the obtained results, FCEV technology emerges as the most favourable both in terms of its potential to reduce GHG emissions and in GDP increase for the country. Both technological solutions demonstrate how the displacement of traditional fuels is far more beneficial in comparison to the environmental burden of new vehicle manufacturing. Results show FCEV technology triggers higher GDP growth and high-skilled employment within the Italian economy rather than BEVs, whose supply chain delineates a greater reliance on foreign activities, particularly for what concerns the exploitation of mining hubs for batteries production. The study thus demonstrates the potential of MARIO framework to comprehensively analyse multiple aspects deriving from decarbonization processes at national level. Further MARIO development is planned to properly consider the dynamic transition processes that could occur during the modelling horizon, as the occurrence of different economic conditions and stages of technological development.

Spatial Stochastic Frontier Models

Topic: Productivity and efficiency analysis I (Chair: Douglas S. Meade, Inforum)
Author: Takahiro TSUKAMOTO

A wide variety of spatial stochastic frontier models, which merge stochastic frontier models and spatial econometric models, have been proposed. However, these models have not been clarified in a systematic way. Thus, we introduce (non-spatial) stochastic frontier models and basic models of spatial econometrics, systematically categorize the spatial stochastic frontier models, and then clarify the characteristics and problems of each.
Concretely, we start with the (non-spatial) stochastic frontier models and review the basic models of spatial econometrics—the spatial lag of X model (SLX), the spatial autoregressive model (SAR), and the spatial error models (SEM). Subsequently, we categorize these three basic models of spatial econometrics in order to review the following examples of the spatial stochastic frontier models—the spatial lag of X stochastic frontier models (SLXSF), the spatial autoregressive

stochastic frontier models (SARSF), and the spatial inefficiency stochastic frontier models (SIESF). Then, we develop a new spatial inefficiency stochastic frontier model. Our spatial inefficiency stochastic frontier model meets the following conditions: (a) It can detect not only positive, but also negative spatial autocorrelation of inefficiency; (b)The inefficiency follows a truncated normal distribution; and (c) It can distinguish whether the detected spatial autocorrelation is caused by an influence from one's own inefficiency on the surrounding inefficiency (true spatial spillovers) or by a lack of spatially dependent determinants of inefficiency (spurious spatial spillovers). Finally, we introduce some application examples of these models, such as Japanese manufacturing and local governments. We also discuss the applicability of input-output table data to spatial stochastic frontier models.

Unit Structure Analysis of Oil Price Pressure: The Case of Japan

Topic: Input-output analysis for policy making II (Chair: Candi Clouse, Cleveland State University)
Author: Aoi TSUKIOKA
Co-Authors: Shigemi KAGAWA, Sora MATSUSHIMA

Crude oil prices have increased by 40% during the period between 2015 and 2022. Thus, the Japanese economy has clearly experienced a rapid increase in the crude oil prices due to the global oil supply insecurity caused by the Russian aggression against Ukraine. It is important to note that the rapid oil price increase has a significant impact on the production cost of industries because they directly and indirectly use crude oil via supply chains. This study focuses on cost pass-through describing that a business entity changes the price of goods or services in response to a change in the energy cost of producing them. To model the cost pass-through via product supply chains, we develop a new cost-pushed unit structure approach that is capable of describing an adjacency matrix by weighting the energy cost increases embedded in transactions between each sector. We then applied cluster analysis to the adjacency matrix to find industry groups with overconcentrated energy cost increased in the supply chain network. From the results based on the 2005, 2011, and 2015-linked input-output tables, we found that the pressure on Japanese economy due to rising oil prices decreased considerably. Furthermore, we observed that fishing-related cluster had the highest effect of the pressure caused by increase in oil prices during the study period. Based on the cluster results identified in this study, policy makers should define a priority for aiding supply chain groups with higher oil price pressure.

CO2 mitigation through the efficiency improvements in the medical sector of Japan

Topic: Productivity and efficiency analysis II (Chair: Douglas S. Meade, Inforum)
Author: Daigo USHIJIMA
Co-Authors: Tomoaki NAKAISHI, Haruka MITOMA, Shigemi KAGAWA

The number of diagnostic imaging equipment such as computed tomography (CT) and magnetic resonance imaging (MRI) mainly used in hospitals has increased by 29.6% during the period between 2002 and 2017 in Japan and thus the capital demand for medical services has grown rapidly due to the aging society. On the other hand, the per capita capital demand (i.e., number of CT and MRI installed in the hospitals per capita) largely varied among prefectures in Japan. This paper focuses on not only economically inefficient operations of the capital equipment in hospitals but also lifecycle CO2 emissions embodied in the capital demand in the medical services. We use a comprehensive hospital database including the number of CT and MRI

introduced, the expected number of medical examinations using the CT and MRI, the number of radiology technologists, and the number of radiologists, and the actual number of their medical examinations and estimated the relative efficiency of 47 prefectures of Japan through the data envelopment analysis (DEA). We find that there existed a considerable potential of reducing CT and MRI equipment in some inefficient prefectures such as Fukui and Kochi. Finally, we conclude that the capital efficiency improvements with a focus on the inefficient hospitals can contribute to mitigating lifecycle CO2 emissions from the medical sector in Japan.

Implementation of a new SUT balancing tool and first experiences

Topic: IO Theory II (Chair: Eva Varga, Hungarian Central Statistical Office)
Author: Eva VARGA

The SUT is an integrated part of the National Accounts compilation in Hungary. In Hungary the SUT has a central role in the final balancing of national accounts. The recently used SNA-NT system (adapted from Norway several years ago) has extra layers which are not part of ESA2010 and it is considered too detailed to fill in the starting tables.
In the framework of a EUROSTAT grant project – with the introduction of a new tool, the Danish balancing instrument – HCSO is intend to speed up the balancing of SUT and integrate the result into the final NA compilation by t+29. This would improve the quality of GDP/GNI data.
The aim of the action was implementing the new Danish system and speed up the balancing of SUT.
The first part of my paper gives an overview of the implementation process.
The second part of the paper focuses on the steps we have made in order to fine tuning the new system into the Hungarian circumstances.
The third part of my paper gives an overview of some problems we have faced during the implementation process and final conclusions.

Modelling the Impact of Clean Environment Cess: Hybrid Energy Input-Output Approach

Topic: Energy Input-Output Modeling I (Chair: Kirsten S. Wiebe, SINTEF)
Author: Rajat VERMA
Co-Authors: Ganesh SIVAMANI

The Clean Environment Cess (CEC) was introduced by the Government of India in 2010 to reduce emissions and tackle climate change. This paper seeks to measure the impact of this cess on greenhouse gas emissions and GDP, both at the sectoral and national levels. These questions have been examined in this study by modelling the impact of CEC in a Hybrid Energy Input-Output (EIO) framework. To the best of our knowledge, such an exercise has not been attempted in the context of CEC. The EIO for India 2015-16 published by CSEP is the major data source that has been utilized. The rate of CEC was Rs.200/tonne in 2015-16, which was increased to Rs. 400/tonne in 2016-17. It was found that this increase of Rs. 200/tonne results in the reduction of the GDP by around 0.15%, while emissions from coal and petroleum products reduce by only 0.07% and 0.17%, respectively. The sector most affected by this cess was the coal sector itself, which sees a reduced output of around 17%. This is followed by minimal output reductions in wood and wood products, crude petroleum, machinery, and non-ferrous basic metals, whose outputs reduce in the range of 0.13% to 1.5%. The reduction in emissions from the sectors also follows the same order, as a reduction in output leads directly to fewer emissions generated.

Thus, CEC alone is not a useful tool to meet climate change targets set by India. However, a similar cess on the production of other high-emitting sectors, such as fertilizers, iron and steel, non-ferrous basic metals, paper and paper products and textile and leather industries, may help.

Resource allocation model for estimation of economic damage of earthquakes

Topic: An Input-Output Analysis for Disaster Damage: A Case Study on the Tokyo Epicentral Earthquake (Chair: Kiyoshi Fujikawa, Aichi Gakuin University)
Author: Takatoshi WATANABE
Co-Authors: Kiyoshi FUJIKAWA, Mitsuru SHIMODA

This presentation is the third presentation in the organized session, “An Input-Output Analysis for Disaster Damage: A Case Study on the Tokyo Epicentral Earthquake”
This presentation deals with supply constraints of intermediate goods such as raw materials and components due to Tokyo epicentral earthquake based on Tokyo metropolitan two-regional Input-Output table, which is similar to the previous presentation. However, this presentation analyzes the case where supply constraints are addressed by adjusting the demand quantity, in contrast to the previous report which estimates earthquake damage by estimating the decrease in production when a bottleneck occurs in intermediate goods input. When we call the demand options available to an economy is “the demandable set”, then the occurrence of supply constraints on intermediate goods means a shrink of the demandable set. In this case, it is a policy decision which part of the shrunk demandable area should be selected, in other words, for which products the intermediate good resources should be allocated. It depends on the criteria (objective functions) for policy decisions. Examples of objective functions include maximizing GDP, maximizing consumer utility, or minimizing change from the status quo.
This model is an application of the linear programming. In a traditional input-output analysis, the quantity of final demand is an exogenous variable and the quantity of output to supply it is determined; in this resource allocation model, the quantity of output is an exogenous variable and the quantity of final demand that can be supplied by it is calculated in reverse. In the model in the previous presentation, earthquake damage is estimated by the change in the production volume, but in this model, earthquake damage is estimated by the change in the objective function. The idea of this model is new and has never been presented at an international conference before, and we believe it is important to introduce this model at IIOA because of its significant academic contribution.

Estimating SDG impacts through GVCs on countries that are in the ICIO's Rest of the World region

Topic: Global value chain analysis II (Chair: Kirsten S. Wiebe, SINTEF industry)
Author: Kirsten S. WIEBE
Co-Authors: Carl-Johan H. SÖDERSTEN, Moana SIMAS

Global value chain analysis based on multiregional or intercountry input-output (MRIO/ICIO) tables has been used to quantify and locate the effects that consumption, policies and trade in global value chains have on a range of social and environmental indicators (Wiedmann and Lenzen, 2018), and these effects can be linked directly or indirectly to diverse SDGs (Gomez-Paredes and Malik, 2018). Furthermore, this type of GVC analysis can be used to compare the spillovers of the impacts of future changes in global value chains owing to different policies (Wiebe et al., 2019).

Although the currently available MRIO/ICIO databases provide a somewhat aggregated industry resolution, they are ideal to assess spillovers of policy choices at sector level or within product groups (Schmidt-Traub et al., 2019). The OECD-ICIO, which together with WIOD, best reflects the economic and trade structure of countries, has aggregated many countries into the Rest of the World region. While this region reflects less than 10% of global GDP, almost 30% of the global population live in this region.
Here, we suggest a new approach for assessing impacts of the global green transition on SDGs in the countries that are summarized in the Rest of the World (RoW) region of the OECD's ICIO. We use the example of increasing global diffusion of offshore wind and solar PV for electricity generation, and differentiate between the short term effects due to investment and the long term effects due to the resulting structural change. Assessing the effect of such changes on SDGs will be done in a four-step approach: First, exogenously implementing technological change into the technology and trade structure by introducing additional offshore wind and solar PV electricity industries as "what-if" scenarios. Second, using the multi-regional input-output modelling approach to quanitfy effects on industrial production around the world. Third, based on an analysis of historic relations (econometric estimations) between exports by product and value added, employment (by skill and gender, if available), and GHG and local emissions by industry, assess how these indicators change when exports change. And, fourth, link changes in these indicators to changes in 16 SDG indicators, such as for example SDG indicator 9.4.1 "CO2 emissions per unit of value added", SDG indicator 5.5.2 "women in managerial positions", or SDG indicator 4.3.1 "mortality rate attributed to [...] chronic respiratory disease".

Accounting for within-industry firm heterogeneity in an Inter-Country Input-Output system

Topic: Handbook on Extended Supply and Use Tables II (Chair: Jose M. Rueda-Cantuche, European Commission)
Author: Norihiko YAMANO
Co-Authors: Colin WEBB

A limitation of industry-by-industry Input-Output tables is the assumption that all firms allocated to a particular industry have the same average production function. However, as discussed in previous chapters, production functions of firms within the same industry can vary considerably, particularly in terms of exporting and importing activities. This paper summarises the motivation and statistical and methodological challenges of developing national Input-Output tables accounting for firm heterogeneity (FHIO) and integrating the estimates into the Inter-Country Input-Output (ICIO) Database. Splitting manufacturing industries to distinguish between processing firms and other firms in China and, “global manufacturers” and other firms in Mexico, has been a unique feature of the latest editions of OECD’s ICIO database. Using numerical examples the procedures for modifying national tables are outlined by reviewing existing statistics availability and the data harmonisation and validating procedures used. The impact of splitting manufacturing industries is summarised by comparing Trade in Value Added (TiVA) indicators derived from standard ICIO tables with those from FHIO integrated ICIO tables. For example, foreign value added content of exports by industry (backward linkages). Using the 2021 edition of OECD's ICIO tables as a benchmark database (covering 67 economies, 45 industries and 24 years), the overall impacts on TiVA indicators are also compared with other granular extension options e.g. the number of target economies and level of industry detail. The analysis confirms that separating the export processing-oriented firms within manufacturing industries has significant impacts on measures of globalisation e.g. particularly for earlier years when countries were in the early stages of integration into global value chains.

Circularity Reinforcement of Critical Raw Materials in Europe: An Input-Output Analysis for the Case of Niobium

Topic: Input-output and the network theory I (Chair: Keisuke Nansai, National Institute for Environmental Studies of Japan)
Author: Devrim Murat YAZAN
Co-Authors: Theresa Simone FREIIN VON RENNENBERG, Luca FRACCASCIA

European Commission (EC) attributes utmost attention to Critical Raw Materials (CRMs) as the related reserves rapidly exhaust and the recyclability rates are low. Hence, implementation of Circular Economy (CE) for CRMs plays a significant role for a sustainable European industry. Niobium is one of the most rare CRMs whose reserves are dominantly in Brazil and its circularity is below 1%. Being used in production of steel, superalloys, and superconducting magnets, scarcity of niobium threatens the future of multiple industries such as aerospace, information-technologies, and construction.

The main research question of this study is: “To what extent does the implementation of a CE strategy impact niobium’s criticality for Europe as well as the generation of waste and emissions along the niobium supply chain?” Three circular scenarios based on potential future technological developments, governmental policies, and resource use pathways for niobium are investigated. The global niobium supply chain is analyzed by an Enterprise Input-Output (EIO) model and the supply risk is calculated for each scenario in accordance with the EC’s criticality assessment framework. The study is novel as the first article proposing multiple CE solutions to tackle niobium’s criticality by using an EIO model.

The results show that urban mining as a CE strategy is a viable solution to reduce niobium’s criticality and to mitigate its supply chain’s negative impact on the environment. A higher recycling input rate or a mix of recycling and substitution strategies is necessary to reach below the criticality threshold of 1 and offset niobium’s criticality. Accordingly, Europe would prevent a shortage of supply by becoming less dependent on Brazil, however, joint efforts of academia, politics and the economic actors are needed.

Environmental and Economic Sustainability of Electric Buses and their Operations

Topic:
Author: Devrim Murat YAZAN
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The electrification of public bus transport are carried out utilizing different technological solutions, like trolley, battery or fuel cell buses. The available technologies are broadly reliable, but in particular, there are still uncertainties about different charging scenarios.
Through a case study in the Netherlands, this study aims to analyze the environmental and economic sustainability of the electric battery bus transportation based on three charging strategies: overnight charging, opportunity charging and the combination of overnight and opportunity charging. Second, this research aims to provide a practical contribution to the stakeholders to better design the operations of electric battery bus transportation. In order to reach these goals, the research question has been identified as: What are the net environmental and economic costs/benefits of battery buses with overnight charging, opportunity charging and the combination of both strategies?

Enterprise input-output (EIO) modeling is adopted to assess the environmental and economic sustainability of the supply chain of battery bus transportation in the case of a bus line operating in a Dutch city. The impact of the implementation of the charging strategies on the sustainability of the supply chain is quantified using scenario analysis. The methodology consists of two model implementation. First, a physical input-output model is adopted to display the material, energy and CO2 emissions which are then integrated into a monetary input-output model via cost/price vectors.
The findings show that the opportunity charging scenario has the lowest primary input consumption and CO2 generation with a yearly emission of 164,314 kg, the lowest environmental costs with € 12,324/year, and the lowest total costs with € 318,608/year. The study is novel as the first one that analyzes the sustainability of electric buses and related operations via EIO model and provides practical implications to municipalities targeting to increase the use of the electric battery buses.

CO2 Reduction Potential of Expanding Car Sharing Services: The case of Japan

Topic: Input-output analysis for policy making I (Chair: Francesco Tonini, Polytechnic University of Milan)
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In September 2020, the Japanese government has declared the goal of achieving a carbon-neutral, decarbonized society by 2050. Looking at CO2 emissions by sector in Japan in 2020, the transportation sector accounts for 18.6% of the total emissions. More specifically, passenger cars account for 45.9% of the total emissions from the transportation sector. Therefore, it is crucial to reduce CO2 emissions from passenger cars in order to achieve the carbon neutrality by 2050. Among the expected evolution of passenger cars in the future, car sharing service is a method that will most significantly change the way we use cars. It is important to understand the effect of expanding car sharing services on the overall CO2 emissions of passenger cars. This study develops a new framework for analyzing the life-cycle CO2 emissions of passenger cars associated with expanding car sharing services in a country. Based on the analysis framework, we quantify CO2 reduction potential of expanding car sharing services in the society through a comparison between the baseline scenario where no car sharing service exists in the society and the counterfactual scenario where the number of car-sharing users increases at a certain rate during the study period between 2009 and 2018. We assume that the percentage of owners choosing car-sharing services would gradually increase during the study period, reaching ρ% in the final year (i.e., 2018). A comparison between the baseline and counterfactual scenarios shows that the ρ=10% increase in car-sharing services would have led to a decrease of 6 million t-CO2-eq. during the study period, accounting for 3% of the CO2 emissions from Japan’s transportation sector. This study finally presents an effective CO2 mitigation policy through improving car sharing services.

Structural change and greenhouse gas emissions: a case study for Argentina during the period 2000-2016

Topic: Structural Decomposition Analysis (Chair: Jose M. Rueda-Cantuche, European Commission)
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The various aspects of structural change are related to climate change in different ways. The sectoral composition of the economy has a direct impact on the environment, through the different contributions that each sector makes in terms of greenhouse gas emissions. Technical change, for its part, plays a central role, since the introduction of green technologies contributes to energy efficiency of production processes, to an increase in the dematerialization of the value added of final products and replacing fossil fuels by renewable energy sources. However, radical innovations may require major changes in the structure of the economy, infrastructure and consumer behavior and therefore can have negative effects on the environment. The change in income distribution, in turn, alters the levels of final consumption, the distribution of consumption between different sectors, and the aversion to pollution on the part of consumers. In conclusion, each of the different aspects related to structural change can have different impacts on the environment, so the net effects of structural change on greenhouse gas emissions is, ex ante, indeterminate.

In this order of ideas, this paper aims to answer the following research question:

What is the effect of structural change on the level of greenhouse gas emissions in Argentina?

The main goal of this article is to determine the contribution of the technological change and the sectoral composition, along with changes in final demand and the energy intensity associated with the production processes, on the levels of greenhouse gas emissions in Argentina, during the period 2000-2016.

The method used to achieve this goal consists on a structural decomposition analysis of environmentally extended input-output matrices (which incorporate satellite accounts of greenhouse gas emissions and energy consumption), provided by EORA (https://worldmrio.com). This type of study has not been carried out so far for Argentina.

Digitalization, positioning in global value chain and carbon emissions embodied in exports

Topic: Global value chain analysis II (Chair: Kirsten S. Wiebe, SINTEF industry)
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Abstract:
Globally, the rapid digitalization process has been altering production and consumption patterns for decades, and as a result, it has become a critical enabler of a low-carbon economy. This study examines the impact of digitalization and the position of global value chain (GVC) on carbon emissions embodied in exports (CEEE). We do so by incorporating total trade accounting method into the traditional MRIO model from the perspective of the GVC specialisation system and computing the CEEE on the production side. We use high-dimensional fixed-effect models and three-dimensional panel data covering 18 manufacturing industries in 38 economies from 2000 to 2014. The results show that digitalization and CEEE have an inverted U-shaped relationship, with

upgrading GVC positions reducing CEEE significantly. Furthermore, it is easier for developed countries (high-tech industries) to achieve the goal of lowering CEEE by entering the downward phase of the inverted U-shaped curve through digitalization than it is for developing countries (low-tech industries). Moreover, improvements in GVC position in developed countries (high-tech industries) have a greater impact on CEEE reduction than in developing countries (low-tech industries). Finally, the nonlinear moderating effect model findings show that upgrading GVC's position weakens (or smooths) the inverted U-shaped relationship between digitalization and CEEE, shifting the curve's turning point to the left. Therefore, in order to achieve the goal of global sustainable development, a country's focus should be not only on digitalization and its development, but also on actively improving its position in GVC.

Rising carbon inequality and its driving factors from 2005 to 2015

Topic: How the rising of emerging economies can reshape the world? II (Chair: Jing Meng, University College London)
Author: Heran ZHENG

Around 80% of the volume of international trade is carried by sea. Port is the key infrastructure for the international trade and is also under the threat of climate change. Climate disaster may disrupt the port operations, and consequently lead to the economic or labour loss. It is particularly for China's ports, given the status of world factory. However, the impacts of climate disasters on global supply chains due to the disruption of China's ports are still less understood. Here, we link micro-level customs data with global MRIO model to allocate China's international trade into China's 50 main ports. We illustrate the scale of global GDP related with each China's port. Then, we simulate the scale of GDP loss in different climate scenarios (probability of climate disaster) due to the disruption of China's ports. The study aims to gaining insight into how climate disasters on transportation-hotspots in the future affects the global supply chain.

The Effect of Educational Status on Household Energy Consumption in Urban and Rural China

Topic: Regional IO analysis (Chair: Shigemi Kagawa, Kyushu University)
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Education is an important proxy for social development and has complex but understudied impacts on household energy consumption (HEC). Using China's household survey data and an energy input-output (EIO) model, this paper estimates the influences of education on direct and indirect HEC in urban and rural China in 2017. We thereby distinguish four different educational groups in both areas. The empirical results show that education affects direct and indirect HEC in different ways. We hypothesize that households with more education have (1) higher levels of income which provides them access to various energy sources, and (2) a larger awareness of environmental issues. This hypothesis is corroborated by our findings. Considerable gaps in direct HEC per capita can be observed between the least educated households on the one hand and the other three groups on the other hand. This holds both in rural and in urban China. Our results also show that the least educated households have the smallest amount of direct HEC per capita. Households with more education have a more environmentally friendly energy consumption structure and spend a smaller share of their direct HEC on coal. On the other hand, we find that education positively influences the indirect HEC per capita. This is because households with a

higher educational status consume more indirect HEC due to their different consumption patterns. More attention should be focused on the role of education and on emphasizing energy awareness.

Estimation and Applications of OECD Inter-Country Input-Output (ICIO) Tables in Previous Year Prices (PYP)

Topic: Global value chain analysis III (Chair: Carmen Zürcher, OECD)
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While trade in value added (TiVA) indicators have been widely used to analyze global value chains (GVCs), they are usually created in current prices and their evolution over time does not allow to disentangle changes in value-added trade flows related to prices from changes in volume that reflect some reorganization in supply chains. Take for example the case of how important fluctuations in the price of raw materials can affect GVC indicators and may explain part of the 'deglobalisation' observed in 2011-2016. In such a way, to disentangle these changes related to inputs prices from structural changes and to better understand the reorganization of global value chains in the last two decades, the OECD Inter-Country Input-Output (ICIO) tables (from 1995 to 2018, for 67 economies and 45 industries) are estimated in previous year's prices (PYP) and GVC indicators created in chain-linked prices. The advantage of such methodology, as compared to constant prices, is that there is no need to create tables using a common base year. The proposed methodology is based on previous work done within the WIOD project (Timmer et al., 2015). These tables can also have further applications as they will allow to measure changes related to physical indicators, like emissions, use of energy, etc. and also be used in studies related to changes in capital and labor productivity. The OECD will make these tables in previous year's prices publicly available.

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TAKAYABU, HIROTAKA	KINDAI UNIVERSITY, JAPAN	
TEMURSHO, UMED	IOPEDIA, SPAIN	Parallel Session 6, Aquamarine
TIMOFEEV, ANDREY	GEORGIA STATE UNIVERSITY, UNITED STATES	Parallel Session 5, Crystal
TOKITO, SHOHEI	YAMAGATA UNIVERSITY, JAPAN	
TONINI, FRANCESCO	POLITECNICO DI MILANO, ITALY	Parallel Session 5, Crystal

FULL NAME	INSTITUTION, COUNTRY	CONFERENCE PRESENCE
TSUKAMOTO, TAKAHIRO	CHUKYO UNIVERSITY, JAPAN	Parallel Session 1, Jade
TSUKIOKA, AOI	KYUSHU UNIVERSITY, JAPAN	Parallel Session 6, Emerald
USHIJIMA, DAIGO	KYUSHU UNIVERSITY, JAPAN	Parallel Session 2, Jade
UTIT, CHAKRIN	UNIVERSITI PUTRA MALAYSIA, MALAYSIA	
VALDERAS JARAMILLO, JUAN MANUEL	UNIVERSIDAD DE SEVILLA, SPAIN	
VARGA, EVA	HUNGARIAN CENTRAL STATISTICAL OFFICE, HUNGARY	Parallel Session 7, Diamond
VERMA, RAJAT	CENTRE FOR SOCIAL AND ECONOMIC CHANGE, INDIA	Parallel Session 6, Diamond
WAKIYAMA, TAKAKO	UNIVERSITY OF SYDNEY AND IGES, JAPAN	
WATANABE, TAKATOSHI	AICHI GAKUIN UNIVERSITY, JAPAN	Parallel Session 1, Crystal
WEBB, COLIN	OECD, FRANCE	
WIEBE, KIRSTEN	SINTEF, NORWAY	Parallel Session 2, Topaz
WOLF, RAYAN	UNIVERSIDADE FEDERAL DE VIÇOSA, BRAZIL	
WONG, KHEE FUNG	STATISTICS NETHERLANDS, NETHERLANDS	
XUE, JINJUN	GRADUATE SCHOOL OF ECONOMICS, NAGOYA UNIVERSITY, JAPAN	
XUE, LIAN	CHINA INSTITUTE OF DEVELOPMENT STRATEGY AND PLANNING, CENTER FOR INDUSTRIAL DEVELOPMENT AND REGIONAL COMPETITIVENESS, WUHAN UNIVERSITY,, CHINA	
YAMANO, NORIHIKO	OECD, FRANCE	Parallel Session 2, Diamond
YANG, CUIHONG	SOUTH BUILDING, ACADEMY OF MATHEMATICS AND SYSTEMS SCIENCE, CAS, CHINA	
YAZAN, DEVRIM MURAT	UNIVERSITY OF TWENTE, NETHERLANDS	Parallel Session 1, Ruby
YE, XIANJIA	UNIVERSITY OF GRONINGEN, NETHERLANDS	
YOSHIZAWA, DAISUKE	KYUSHU UNIVERSITY, JAPAN	Parallel Session 5, Crystal
YOSHIZAWA, TOMOAKI	KYUSHU UNIVERSITY, JAPAN	
ZAMORANO, GERMAN	FEDERAL UNIVERSITY OF RIO DE JANEIRO, BRAZIL	Parallel Session 4, Aquamarine
ZHANG, YANAN	INSTITUTE OF REGIONAL AND URBAN-RURAL DEVELOPMENT, WUHAN UNIVERSITY, CHINA	
ZHENG, HERAN	UCL, UNITED KINGDOM	Parallel Session 6, Topaz
ZHU, LINGXIU	UNIVERSITY OF GRONINGEN, NETHERLANDS	Parallel Session 7, Emerald
ZOTTI, JACOPO	UNIVERSITY OF TRIESTE - DEPARTMENT OF POLITICAL AND SOCIAL SCIENCES, ITALY	
ZÜRCHER, CARMEN	OECD, FRANCE	Parallel Session 3, Emerald Parallel Session 3, Emerald