



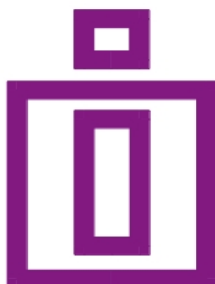
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*BOOK OF ABSTRACTS  
AND LIST OF AUTHORS*

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## **LATIN AMERICA AND CHINA: Multilateralism or dependency? An approach of Computable General Equilibrium for selected countries**

Topic: CGE & Trade

Author: Damares Lopes Afonso

Co-Authors: Suzana Quinet de Andrade Bastos, Fernando Salgueiro Perobelli

This article is intended to contribute to the debate on relations between China and Latin America (LA), the question is whether the trade agreements among China and LA are complementary (multilateral) or strengthen the dependence of the LA on the international scene. For this, this article proposes to observe the impacts of the growth of the Chinese economy on production, export and import and in welfare variation in selected countries of LA and China itself. The model Computable General Equilibrium of the Global Trade Analysis Project (GTAP) is used in version 9. The Chinese growth was simulated by the expansion of this country's stock capital by 10%, which corresponds to the average growth of the capital stock of the China between 1990 and 2014, according to Penn World Table 9.0. The results point to a pattern of reprimarisation of the export agenda and a drop in industrial activity in the selected LA countries, especially in the high technology density sectors. In addition, there is an increase in welfare in LA, mainly due to gains in terms of trade (commodity boom). In contrast, China has been increasing the industrial output and technological density of its products, so that China is no longer an exporting economy of cheap manufactured goods and is competing in high technology segments. So the question is: multilateralism or dependence on trade relations between China and LA? LA is a source of natural resources, however, dependence on the production of these resources makes the region vulnerable on the international stage, ie susceptible to booms and falling commodity prices. Chinese economic growth and the consequent increase in demand for commodities by China demonstrate the degree of specialization in the production and export of the LA as well as its fragility in competition in industrial segments.

## **A disaggregated MRIO model for the Ebro River Basin (Spain)**

Topic: Regional energy & environment

Author: Miguel Ángel Almazán-Gómez

Co-Authors: Raquel Langarita, Rosa DUARTE, Julio Sánchez Chóliz

A previous study about the Ebro Delta Environmental Flows, which considers only two regions (Aragon and Catalonia), revealed us the existence of a seed of water-conflict between these regions of the Ebro River Basin. That previous work suggests the need of analyzing the water flows and water needs between all the regions in the basin. This encouraged us to study the water-related environmental issues from a basin perspective.

To assess water uses and to get a deep socio-economic and environmental view, the present work aims to construct a multiregional input-output (MRIO) model for the whole Ebro River Basin and linking it with Geographical Information Systems (GIS). In this way, the environmental impacts will be identified much more concretely, and the river can be treated as a water stream. In other words, we will be able to identify the pollution hotspots and quantify the environmental damage in concrete areas as well as along the water stream. In addition, being able to recognize the river and its tributaries as a water stream allows to simulate more realistic scarcity scenarios. The Ebro River runs for 565 miles (910 km) in a south-easterly direction across northeast Spain to its delta on the Mediterranean coast midway between Barcelona and Valencia. It has the largest discharge of any Spanish river, and its drainage basin, at 33,000 square miles (85,500 square

km), is also Spain's biggest. The Ebro River Basin (ERB) provides water to more than three million people in more than 1,700 towns and villages. The basin is characterized by high levels of evaporation and evapotranspiration, and low, irregular rainfall. Another main feature about this basin is that it contains, partially, nine autonomous communities of Spain: Aragon, Cantabria, Castile la Mancha, Castile-Leon, Catalonia, Valencian Community, La Rioja, Navarre, and Basque Country. So, the developing of its input-output table (IOT) implies to construct a MRIO table.

This integrated table and the associated model would be the first for this large region. The main data, for 2010, come from the Regional IOTs obtained from the Regional Statistical Institutes of each autonomous community (updated and harmonized to 2010 using the GRAS algorithm), the Spanish interregional trade (c-interreg) database and the Environmental Satellite Accounts from Spanish Statistical Institute. The regions are not completely in the basin, so, we approach the part of each of the sectors that are inside the basin with data from "Analysis System of Iberian Balances" database (SABI in its Spanish acronym). With this, we pass from the administrative borders to the physical one for the whole basin. However, we maintain the administrative borders inside the basin for our analysis. This allows us to obtain a more detailed interregional analysis as well as to gain in accuracy when disaggregating the primary sector. Moreover, we will be able to study some conflicts scenarios between regions.

The main contribution of this work is the elaboration of a MRIO table for a basin which is not conformed by complete administrative regions. Due to our interest in water, we have disaggregated the most water-related sector: primary sector has been disaggregated into 36 crops (18 irrigated and 18 rainfeed) and 6 livestock groups using data from MAPAMA (Ministry of Agriculture, Livestock, Fisheries and Environment of Spain). As the effects in water resources are usually located in small and specific areas, and MRIO models usually inform about environmental impacts at a country or regional level only, we propose to extend the MRIO model with GIS layers using ArcGIS software. In this way, we will be able to estimate the water footprint for specific hotspots in the water stream and to propose and analyze scarcity scenarios. We will also analyze and plot water-yield and water-scarcity maps at municipality level.

Meanwhile, we have also developed a hydro-economic model for the Ebro River Basin. For this model, using the information contained in the MRIO table we design different cost and revenue functions for each crop and for each region. Moreover, the MRIO table will also be useful for several applications, such as the calibration of a computable general equilibrium (CGE) model. In fact, we are working on linking the CGE with the Hydro-Economic Model.

## **APPLICATION OF MULTIVARIATE ANALYSIS AS COMPLEMENTARY INSTRUMENT IN STUDIES ABOUT STRUCTURAL CHANGES: AN EXAMPLE OF BACKWARD AND FORWARD LINKAGES IN THE AMERICAN ECONOMY**

Topic: Mathematical analysis of input-output data

Author: Lucas Milanez de Lima Almeida

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This paper aims to show that the use of multivariate analysis facilitates comparative static studies on the economy from a sectorial approach. Our study presents a complementary perspective to the use of this technique in economic problems involving structural changes. The main objective was to use cluster analysis to identify when the patterns changed. This was done through a comparison of information about the economic structure in the same location at different times. If the features of an economy at one moment are similar to those registered at other times, these two periods were placed in the same cluster; otherwise, these two periods belonged to different clusters. Our aim was to make a comparative static study where the

outcomes are expressed in groups of years with similar features about the economy. The main advantage of applying cluster analysis to I-O is that all information about the economic structure is considered, including its temporal component. This enables the precise identification of when a structural change manifested itself. Usually, studies select subjectively the years that will be analyzed. Furthermore, in our study, given the temporal patterns that may be identified in the economy as a whole, the analysis makes it possible to show the modifications of the individual sectors over time. An established algorithm of cluster analysis, proposed by Frey and Dueck (2007), and called affinity propagation, was used to find some temporal pattern in the annual rank of Rasmussen's indices of linkages in the US economy between 1997 and 2015. The data were obtained from US Bureau of Economic Analysis website. Three different measures were compared to analyze each type of linkage year-by-year: Negative Square Euclidean distance, Pearson's correlation coefficient, and Spearman's rank correlation coefficient. The outcomes to backward linkages were the same for all measures. In turn, three different results were produced to forward linkages. The negative Euclidean square distance formed only three clusters. The two correlation measures formed four clusters for each one but they were grouped in distinct years. Backward linkages were more sensitive to the business cycle than the forward linkages. On the one hand, confirming the established conception from an Input-Output point of view, structural changes in US economy did not occur suddenly within the period analyzed. On the other, by challenging the common use of a five-year period for a comparative analysis of the economic structure, the study showed that this was not necessarily the ideal amount of time to identify essential changes. As a whole, the sectors that lost the most importance in the American economy were manufacturing activities.

## **A supply-driven model able to endogenise simultaneous homogeneous and heterogeneous primary inputs: overcoming the Ghosh model's limitation**

Topic: Sraffa and Ghosh

Author: Aleix ALTIMIRAS-MARTIN

The Ghosh model, known as the supply-driven model, has been put aside by the input-output community because its interpretation is not clear. The main issue is that, by applying an supply-driven model to the economic system, the primary input increase of a specific sector is pushed forward to all sectors linked to it, without any increase in the primary inputs of these other sectors. This outcome is troubling since it has been interpreted as if the other sectors could produce some output without actually using any input themselves. Analytically, the issue is that the Ghosh model is not able to deal with simultaneous primary inputs of the same type (i.e. homogeneous, from the same row) and different type (i.e. heterogeneous, from different rows).

This paper develops a new supply-driven model that overcomes this issue. In particular, the new model is able to push an increase of a primary input through the economy and calculate all required primary inputs of the other sectors, both homogeneous and heterogeneous, associated to that increase in activity.

The structure of this paper is as follows. First, a literature review illustrating the evolution of the Ghosh model interpretation and criticisms is provided. Second, the new supply-driven model able to endogenise and calculate simultaneously the homogeneous and heterogeneous primary inputs is theoretically developed, highlighting the difference with the traditional Ghosh model. Third, a case study is provided by applying the new model to a conventional monetary input-output table (MIOT). Fourth, for completeness, the traditional Ghosh model is also applied to the same MIOT. It

is found that the new model provides very different results than the traditional Ghosh model (different primary inputs, intermediate flows and final outputs). It is demonstrated that this is because both models answer different questions: the new model reveals what is the new level of overall activity due to the primary input push of a single sector while the traditional Ghosh model reveals where does a unit of primary input end up (i.e. in which final demand it is embedded).

To sum up, this paper develops a new supply-driven model overcoming the inherent limitations and associated criticisms of the traditional Ghosh model. The analytical interest on supply-driven models might consequently be rekindled, especially since supply-driven models provide a different view on the economic structure, answering different questions than the Leontief model (e.g. what primary inputs are complementary to each other or how primary inputs are allocated within the economic system).

## **Analysis of Trade Facilitation policies on customs clearance time**

Topic: CGE & Trade

Author: Habtamu Shiferaw Amogne

In most product lines other than agricultural products, tariffs are generally low, as they have been liberalized first under the auspices of the General Agreement on Tariffs, Trade, and the World Trade Organization (WTO), and subsequently in the context of regional and bilateral preferential trade agreements. For developing countries, tariffs have also become less of an impediment because of Generalized System of Preferences programmes and other preferential schemes. As a result, there is a dramatic shift toward non-tariff barriers in recent multilateral and preferential trade agreements.

Empirical evidence shows that poor-quality border management and logistics have a negative effect on trade. A 1 percent reduction in the cost of exporting or the cost of international transport is associated with an export diversification gain of 0.3 percent or 0.4 percent respectively, in a sample of 118 developing countries (Shepherd and Dennis 2007). For sub-Saharan countries, a one-day increase in inland transit time reduces exports by 7 percent on average (Freund and Rocha 2010). Further, A 10% reduction in the time it takes to move cargo from the production line to the ship increases exports by 4%, all else being equal (Djankov, Freund, and Pham 2010). Removing unnecessary barriers to timely delivery is therefore of utmost importance and trade facilitation has been pointed out as an important tool in this respect. To address this issue, WTO members concluded negotiations at the 2013 Bali Ministerial Conference on the landmark Trade Facilitation Agreement (TFA), which entered into force on 22 February 2017. 3

Despite the importance of trade facilitation policies to reduce trade cost and improve customs performance, relatively little has been done so far. My analysis uses similar approach to Walmsley and Minor (2016) but extends the work in the following way. First, I use the new doing business database, which provides the values of customs clearance time in hour. This reduces the complication in previous two analysis due to the non-continuous values of customs clearance times. Second, under the new methodology, doing business customizes the case study assumptions for exports and imports. This provides an opportunity to analyse the difference in the result with the new assumptions and contrast my result with the previous one. Third, in the new doing business database the customs clearance time is divided in to three broad categories; Border compliance, documentary compliance and domestic transport. The customs clearance time for border and documentary compliance is very different and the impact of trade facilitation

policies differ for each type of compliance. Therefore, this analysis adds to the existing literature by analyzing the impact of trade facilitation policies for each type of compliance.

The study has three main objective. First, to estimate the impact of trade facilitation policies on customs clearance time. Second, to calculate the potential customs clearance time saved when all countries fully implement all trade facilitation agreements. Third, estimate the welfare and macroeconomic impact of trade facilitation policies using willingness to pay approach. The main research questions are: which trade facilitation policy has greatest impact on reducing customs clearance time for both export and import? Which trade facilitation policies are more associated with import time clearance and which are with export time? How much is the potential reduction in customs clearance time when all countries fully implement WTO trade facilitation agreement? Does trade facilitation agreement improve welfare across income groups? What is the impact of trade facilitation agreement on real GDP? The result for 2015 cross-section analysis indicates that Fees & Charges and Formality-document significantly reduce time to export for documentary compliance. Both variables have coefficients that are economically significant - a one-point move in each index (on a 0-2 scale) produces a reduction in reported time to export for documentary compliance of over 68% and 48% respectively. In case of time to export for border compliance, both formality documents and governance have statistically significant coefficient at 10 % and 5% levels, respectively. A one-point move in each index (on a 0-2 scale) produces a reduction in reported time to export for border compliance over 35%. For import clearance time, both fees & charges, and formality-documents have economically significant coefficient - a one-point move in each index (on a 0-2 scale) produces a reduction in reported time to import for documentary compliance of over 50%. For border compliance, only formality-document have economically significant coefficient at 5% level - a one-point move in each index (on a 0-2 scale) produces a reduction in reported time to import for border compliance of over 45%.

## **Environmental Costs of European Union Membership: a Structural Decomposition Analysis**

Topic: Structural decomposition

Author: Inácio Fernandes de Araújo Jr

Co-Authors: Randall Jackson, Amir Borges Ferreira Neto, Fernando Salgueiro Perobelli

There is a major transformation underway in international trade flows that is intensified by multilateral trading system agreements. The consequence of this transformation in international trade is a greater production and commercial integration among countries, the insertion of certain economies into specialized markets in the world, the expansion of production scale, and the fragmentation of the production and distribution of intermediate and final goods. One instrument that fosters the increase of international trade, and is of particular importance to this paper, is the formation of monetary unions or free trade areas.

The interest in this paper lies in the environmental costs of EU. For the specific aim of this paper, we are interested in the wave that occurred in the 2000s. EU membership requires a series of economic and political changes that should impact the country's production and consumption structures and its trade relationships. These, in turn, should affect the CO2 emissions sources and levels. This is especially true for countries that entered the EU recently since there is a clear distinction in levels of development, and perhaps more interestingly, because most of these countries were part of the Soviet Union (URSS).

To quantify the main causes of changes in emissions, we employ a structural decomposition



analysis (SDA), which enables us to disentangle the different drivers of such changes, namely: emissions intensity, industrial structure and sourcing, consumer preferences, final demand sourcing and consumption level. We use the World Input-Output Database (WIOD) and the countries grouped into five clubs or regions: New European Union countries (NEU), Old European Union countries (OEU), the United States of America (USA), China (CHN), and the Rest of the World (ROW). By creating these groups, we are able to quantify emissions costs of the entrance of the new countries into the EU.

## **Chilean Labor Market Evolution Data Production at National and Regional Level and Its Relevancy for Modeling the Economy**

Topic: Modeling the Chilean Economy to Analyze the Future of its Mining Sector

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Co-Authors: Esteban A Lopez Ochoa

Using the Chilean National Labor Market Survey (ENE and NENE) an employment, unemployment, worked hours and total labor series is built concatenating different periods which demands an effort to match different definitions of sectors that workers belong to. Next stage, this data is used to build Use and Make matrices to estimate regional input-output tables for the Chilean 15 regions, coupling this data with the information at national level available in the commodity-by-activity tables from the Central Bank for the years 1996, 2003, 2008-2014. There is an interesting issue in the data preparation process due to there was a change in the methodology of collecting the labor market data that demand and additional modeling effort for the period where both surveys were running at the same time. The new methodology change the old employment and unemployment definitions, which increases the number of workers by a significant percentage of the labor force. Concatenating this to series demanded a significant effort and the results were crucial to built the regional input-output tables.

## **CAPITAL INCREASE IN BRAZILIAN AGRICULTURE SECTOR: A VISION BASED ON COMPUTABLE GENERAL EQUILIBRIUM MODEL**

Topic: CGE & Agriculture and food

Author: Guilherme Asai

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In the last decade, the Brazilian agriculture has undergone several changes. One of them is the increase of grains production such as soybeans and corn beans which raises Brazil as one of top producer and exporter for these grains. To reach this position, was necessary to increase the planted area, by doing this the grain production expanded for unexplored areas that creates a new agricultural frontier between the states of Maranhão, Piauí, Tocantins and Bahia, all in the Brazilian northeast. At the same time, consolidated grains planting areas were modernized in center-west and south of Brazil. The need for more areas of plantation caused an increase in the value of land, which caused an increase in the capital employed. Therefore, all Brazilian agriculture and livestock were affected by this increase in land values. In this scenario, what are the economic impacts (prices of the grains, production value and quantity exported) that the increase in the land value causes in Brazilian agriculture sector? To answer this question, the present paper will use a computable general equilibrium model and the main data input in the model is an Input-Output Table structured to represent the five macro-regions of Brazil and those interactions around the globe. The computable general equilibrium model chosen is the Project of

Analysis of General Equilibrium of the Brazilian Economy (PAEG) developed to represent a Brazilian economy in 19 sectors and 12 regions (five macro-regions of Brazil and seven other regions). Using this model, the main objective of the paper is to quantify the gains in production by the increase in invested capital. Thus, this paper deals with a current and important theme for the Brazilian agriculture, that can help making efforts and decision by measure the impacts in increasing the planted area in the medium and long term.

## **IMPACTS OF THE ECONOMIC SUBSIDIES PROGRAM TO INNOVATION: EVALUATION OF LONG-TERM EFFECTS ON THE BRAZILIAN ECONOMY**

Topic: Welfare programs

Author: Domitila Santos Bahia

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This thesis proposes to investigate the effectiveness of one of the public policy instruments to foster research, development and innovation (P, D & I) in Brazil, the economic subsidy to innovation. The practice of fiscal and financial incentives for innovation is commonly adopted by a number of countries with the aim of stimulating the private sector to expand its innovative efforts to increase competitiveness and contribute more forcefully to local economic growth. Empirical studies have tested the existence of the effectiveness of Brazilian policies in several ways and point to positive effects in terms of expanding the innovative effort of companies benefiting from some kind of legal program in relation to non-beneficiary companies. The objective of this work is to propose an alternative evaluation, testing by means of a computable general equilibrium model, how much the productive sectors of the Brazilian economy have benefited by the concession of the economic subsidies to the activities of technological innovation in the companies. In addition, in order to adequately characterize this group of beneficiary companies, multivariate analysis techniques will be used to capture the specific configurations that can generate a common profile of the target companies of the public policies related in this work.

## **EXCHANGE RATE AND TRADE ELASTICITIES: A MULTISECTORAL AND MULTICOUNTRY ANALYSIS**

Topic: Policy Analysis with Interindustry Models

Author: Rossella Bardazzi

Co-Authors: Leonardo Ghezzi

The foreign exchange currency market is typically characterized by an ingrained uncertainty in a regime of flexible exchange rates as recent years have shown. The protectionist policy of the US administration is driving down value of the US Dollar but, at the same time, the decision of the Federal Reserve to gradually raise nominal interest rates has contributed to attract capital flows that should determine a Dollar appreciation. On the European side, the political instability due to general elections in some countries, independentist pressures in Cataluna, Brexit, and an unsolved problem of governance for the EU, all contribute to the Euro weakness with respect to US currency. All these elements, and many others, have contributed to large movements in terms of bilateral exchange rates and make difficult to predict the value of the currencies in the future. Despite several studies try to demonstrate that exchange rates matter far less than they used to for trade (Bahmani-Oskooee and Ratha, 2008), some others proved that exchange rates still

matter for international trade (Leigh et al., 2015; Verhoogen, 2008). In this paper, we aim to quantify the impact of alternative scenarios in terms of US Dollar-Euro exchange rates in the next 5 years on the bilateral trade flows among European countries, US, and China.

To explore this issue empirically, a trade model is needed that represents the linkages among the main players in international markets at the bilateral level. We use a Bilateral Trade Model (BTM) to simulate the effects of different exchange rate scenarios and to quantify how the import shares of European countries and their competitors are affected sector by sector. As described in Bardazzi and Ghezzi (2017), the main features of the BTM are (i) a dataset of bilateral trade flows, (ii) a detailed disaggregation of commodity classifications, (iii) econometric estimation of import shares, and (iv) a system linking national multi-sectoral models. A high level of disaggregation of trade flows is particularly useful to fully capture the complex interrelations between economies, to investigate issues of international competitiveness, and to simulate the detailed aspects of trade policies which are often tailored to specific commodity categories. We use data from the UN- Comtrade and the EU - Comext datasets to quantify the bilateral trade flows between countries and National Accounts information about investments and prices to estimate share equations. Unlike other multi-country models where trade shares are exogenously assumed, either with parameters drawn from the existing literature or with exogenous hypotheses, in the BTM import shares are endogenous and estimated econometrically as a function of a set of explanatory variables at the commodity level. Finally, the BTM system linking national models enables understanding of the transmission channels of shocks via international trade to detailed industries at the national level, with country models designed so that they mirror the specific characteristics of the national economic systems. Therefore, the overall linking system of BTM and the national multisectoral models allow to estimate direct and indirect feedbacks between the economies included in the model through international trade flows.

The main contribution of this paper is to measure the economic impact of exchange rate movements in the next future. Despite it is well-known that exchange rate movements affect countries exports, in the related literature there is no consensus on the size of this effect. Macro empirical analyses tend to produce very low estimates for the elasticity of exports to the exchange rate, while micro theoretical models tend to justify a higher level of this elasticity. Our analysis takes into account a high level of country structural diversification connected with high commodity disaggregation. The estimation of detailed trade elasticities gives us the opportunity to measure a differentiated impact of exchange rates movements on the national economic systems.

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## **Perspectives on Tourism and Poverty alleviation in Iran**

Topic: Sustainable Development Goals

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Tourism has become a significant industry in each country because of its important socio economic development. Serious study of the Tourism began in the mid-1960s with the seminal book produced by Clawson and Knetsch (1966) on the Economics of Outdoor Recreation. Four years later, Gray (1970) published a very enlightening book on the interrelation between international travel and trade. From then onwards, tourism gradually gained momentum among economists (Dwyer et.al. 2011). There are several research areas relevant to the wider context of tourism studies, that Iranian tourism economists have virtually neglected. These include mostly poverty alleviation due to fording tourism expansion. Iran's International tourism has grown in both number of arrivals and the income receipt very slowly. Tourism could bring a lot of advantages in social and economic life of the host country.

Iran's tourism industry looks set to grow rapidly following the lifting of economic sanctions, with more foreigners looking to visit and plans being made for the development of tour companies, hotels and tourist facilities. In this direction the main purpose of this paper is to study the impact of foreign tourism on the Iran's poverty alleviation using the Foster-Greer-Thorbecke (FGT) poverty index in a Social Accounting Matrix (SAM) framework. FGT index can be used in order to study the distributive effects of exogenous shocks of foreign tourism expenditure on poverty alleviation. For this purpose, the main data bases are: a) 2011 SAM, has been constructed by Parliament Research Center of Iran, b) total income of international Tourism in 2011, c) 2011 rural and urban household incomes.

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## **THE INFORMALITY IN MEXICO: WHO ARE THE TRUE LOSERS?**

Topic: Gender and inequality

Author: Luz Dary Beltrán Jaimes

Co-Authors: María C. Delgado

In Mexico, more and more people are opting for the informal market as a means of subsistence, a situation that has led to considerable losses in terms of tax collection by the national government, especially income tax and social security. This has motivated us to ask ourselves, how much is being left to collect annually for taxes in this situation? What macroeconomic impact would the Mexican economy have before an exogenous impact in said amount? What impact would such collection have on the well-being of the population and inequality? For this, the National Household Income and Expenditure Survey (ENIGH) and a Social Accounting Matrix (SAM) constructed for Mexico for 2012 are used as a database. For the analysis, the Leontief model extended to an SAM is followed which seeks to determine the impact on the welfare of the population from the equivalent variation and the impact on inequality measured through the Gini Index. This research yields interesting results, which allow to make sound public policy decisions, focused on improving the distribution of income and in turn improving the welfare of the population

## **Input-Output and Measuring Economic Productivity in Brazil from 2000 to 2013**

Topic: Growth Accounting

Author: LUAN VINICIUS BERNARDELLI

Co-Authors: Ricardo Luis Lopes

Determining the factors that increase productivity is one of the leading problems of scientific studies once the growth in productivity provides good results to the income level, welfare and is a vital source of economic growth in many economies (Miller e Blair, 2009). Thus, the main purpose of this paper is to analyze total factor productivity (TFP) growth of the Brazilian by the input-output matrices provided by NEREUS, Guilhoto & Sesso Filho (2010), and Guilhoto & Sesso Filho (2005) from 2000 to 2013. The motivation for this study was brought about due to the need to present a different method for estimating TFP growth by analyzing TFP using the input-output methodology. The main results from this study can be compared with the results from other studies that use a different methodology to estimate TFP growth. The outcomes indicate that the Oil and Gas Extraction (+60,78%), Domestic Services (+55,78%) and Public Education (+52,44%) showed the highest productivity increase. On the other hand, the sectors of Financial Intermediation, Insurance, Private Pensions (-45,52%) and Private Health (-31,45%) showed the most significant reduction in productivity. So, this study helps to understand the growth of productivity in Brazil better and provides some results to guide government policymakers shortly.

## **Land footprints and the use of high product and country resolution in multi-regional input-output modelling**

Topic: Global databases

Author: Eivind Lekve Bjelle

Co-Authors: Johannes TÖBBEN, Konstantin STADLER, Sarah Schmidt, Kirsten S. WIEBE, Richard WOOD

Multiregional input-output (MRIO) databases are becoming available with increasingly more detailed data. However, there is still no MRIO databases with high harmonized sector detail and high country detail. Minor countries are often aggregated into so called rest of the world (RoW) regions in IO databases such as WIOD and EXIOBASE (Stadler et al., 2014). However, as better data are becoming available in the source databases, and computational methods are improving, so do the possibilities of including detailed country data in MRIOs, replacing the RoW regions. In this work we aim to develop new methods that expand the 49 regions in EXIOBASE to 214 countries (representing the countries with macroeconomic data such as trade, GDP and industry output) and show the relevance for environmental footprint accounting. We apply novel methods to allow for the simultaneous modelling of data at both high (harmonized) sectorial and country resolution in MRIO data using desktop computational capacity for the first time.

Product and service level trade data is provided by Comtrade database, energy trade data is provided by the IEA and UN services databases, while the industry and product output values are provided by the national accounts databases, FAOSTAT and IEA energy balances. We use this data to make an initial estimate of the supply-use tables (SUTs) as per Stadler et al. (2014), but at the individual country level.

A mathematical optimization approach is employed here to ensure internal consistency within the SUTs (balances are held), consistency with country-level macro-economic data, and detailed bilateral trade data.

We assess the sensitivity of results of land footprints using the aggregated and disaggregated

databases, and do a further sensitivity analysis against an aggregated product database to show the quantitative benefits of including both country and product level detail.

## **Sectoral GVC-REER and industry competitiveness in Russia**

Topic: Regional trade

Author: Irina Bogacheva

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We use Rosstat's recent publication of Russian Input-Output Tables (Rosstat, 2017) to study possible evidence of additional explanatory power of sectoral real effective exchange rate adjusted to Russia's participation in global value chains (GVC-REER, (Patel, Wang, and Wei 2017)). These results are opposed to a more conventional measure of industry real exchange rate (Goldberg 2004). Recent literature (Bems and Johnson 2017) stresses importance of inter industry linkages and GVC participation for construction of REER on a country or industry level. This is even more important for Russia, since it has recently been listed as a country with one of the highest levels of divergence in cost competitiveness across sectors (Patel, Wang, and Wei 2017), prompting on a significant sectoral differences in openness and GVC participation.

Historically Russia's participation in GVC is limited to first stages of global value chains. Russia supplies energy and raw materials for manufacturing processes: index of forward participation is estimated at 38.7%, while index of backward participation is about four times less and estimated at 9.36% (Kadochnikov 2015). This brings concerns about diversification of Russia's exports and competitiveness among manufacturing industries (Torvinen and Väättänen 2013).

Following significant depreciation of the Ruble in 2014 Russian manufacturing firms received a cost advantage that has not yet been offset by the Ruble's latest appreciation observed throughout 2017. Against this background, Russian firms' cost advantage along with acceleration in global economic growth gives a clear opportunity for movement along GVC and further increase in manufacturing exports.

Currently Russia's growth potential is held back by the set of long-term structural factors and adjustment to negative external shocks. We study how industry performance could be explained by GVC participation, which is believed to be a potential driver of growth for the Russian economy.

## **Exploring carbon emissions and international convergence in a globalized world: a multiregional perspective**

Topic: Global databases

Author: Lucía BOLEA

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The phenomenon of economic convergence has been analyzed from several perspectives, taking into account the effect of the population, and obtaining diverse results. The common objective in the literature is to study whether economies walk towards a common growth path or tend to diverge over time and the consequences of this path on economic cohesion. However, the analysis of global convergence on CO<sub>2</sub> emissions and the implications in terms of pollution and income-dependence has received barely attention in the literature of convergence. In this paper, we use the multisectoral and multiregional perspective provided by a MRIO model and the associated databases to study the evolution of convergence in CO<sub>2</sub> emissions from three main perspectives: country-sector, country and sector levels. These three points of view allow us to

check whether the phenomenon of convergence or divergence is due to a specific region, a country or a particular productive structure.

Given the relevance that economic structure, international trade and intersectorial links have in the generation of income but also emissions in countries and sectors, we analyze the contribution of these factors to the convergence measures. Additionally, our paper attempts to shed light on the discussion about the effects of population and per capita income growth on global emissions convergence. Specifically, and taking into account the approval of Kyoto Protocol in December 1997 and the Paris Agreement, this work explore the effect that population vs. economic growth have played in the real evolution of CO2 emission trends.

To do this, the information provided by the most recent edition of the World Input-Output Database (WIOD), as well as other information on sectoral CO2 emissions are used.

In our view, the results contribute new dimensions to the issue of international inequality in terms of environmental pressures and open new debates on the relocation of environmental damage, comparative advantage and environmental footprint.

## **Evolution of the global value chains of the Mexican industry in the world economy in Input Output Networks: a comparative study between 1995-2011.**

Topic: National data in Global IOTs

Author: Rafael Bouchain

Co-Authors: Eric Hernández Ramírez, Juan Andrés Ramírez

The objective of this paper is to analyze the evolution of the global value chains of the most dynamic Mexican industries in the process of fragmentation of world production, a phenomenon that has altered the nature of world trade. Since the nineties of the last century Mexico has implemented a policy of strengthening the export maquiladora industry in order to stimulate a dynamic industries to take advantage of the competitive link in global value chains, the most favored have been among others the automotive and electronics. The fundamental question is to evaluate the success and limitations of this strategy in the creation of wealth as well as in the design of policies should be implemented to take better advantage of the escalation in global value chains. The work carries out a comparative analysis with the groups of countries that have managed to mount a successful strategy in the global value chains. At present, this study is important in the face of the threat of Donald Trump to restrict the North American market with Mexico and withdraw from NAFTA, the purpose of restructuring the Mexican import market. The study carries out a comparative analysis with the most successful groups of countries such as the Nordic countries, the Asiatic countries and the OECD countries through the OECD ICIOs in the period 1995-2011. The method used is the theory of graphs by analyzing GVC, centralities and calculating communities. The novelty in the analysis lies in the use of graph theory in the global value chains, and to identify groups of countries that can represent alternative business partners in the medium term.

## **Some notes on the effects of trade in intermediate products on the patterns of specialization**

Topic: GVC upgrading

Author: Gabriel Brondino

Co-Authors: Davide Villani

In recent times, an increasing number of papers have dealt with the problem of establishing to what extent the fragmentation of production or production sharing affects the determinants of the patterns of specialization. As known, differences in technology is one of the main motives for international trade, among others (such as differences in endowments or economies of scale). Models that emphasize this aspect are usually called Ricardian models.

In Ricardian models in which only trade in final goods is allowed, an important criterion to determine in which sector each country will specialize is to compare relative unit labor requirements against relative wages (Dornbusch et al. 1977). If trade in intermediate products is also allowed, to what extent does this criterion still holds? In a recent paper, Baldone et al. (2007) have show, using a numerical example, that, in such context, if this criterion is followed, the pattern of specialization will not lead to minimum international prices. Our purpose is to provide a more formal treatment and analyze the theoretical conditions under which the criterion ceases to hold. For this analysis, we employ linear programming analysis techniques.

The increasing importance of trade in intermediate products also affects the interpretation of relevant empirical indicators to describe the patterns of specialization.

Such indicators are mainly based on final output trade. We attempt to develop alternative indicators complementary to those available in the literature (Breda and Cappariello 2012). Such indicators will be developed within an input-output accounting framework.

The data employed will be the one provided by the World Input Output Database (WIOD) (Timmer et al. 2015).

The work attempts to provide new insights on the discussion around patterns of specialization, contributing theoretically and empirically to the discussion on the relevance of absolute cost advantages in the determination of international specialization.

## **Flow-of-Funds Analysis of the Brazilian Economy**

Topic: International Finance and Trade

Author: Erika BURKOWSKI

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

The purpose of this paper is to investigate financial system in Brazilian economy and its effect on objective economy. The Flow-of-Funds (FOF) framework proposed by Tsujimura and Mizoshita (2003a) is applied to Brazilian economy. We present the compilation process of asset-liability-matrix (ALM) and the ALM developed to Brazilian economy with 6 institutional sectors (household, non financial firms, government, rest of world, financial firm and Central Bank of Brazil) in the liability side and in the asset side, to the years from 2004 to 2009 and from 2009 to 2014. The two periods are defined because of availability of different data-source. From Brazilian ALM, FOF indexes are calculated (power of dispersion, sensibility of dispersion and discrepancy of dispersion). Structural decomposition of change in the discrepancy index is made for selected years (2008, 2009 and 2010) and an additional expansion presents an ALM with 4 additional financial firms, three government-sponsored banks: Banco do Brasil (BB), Caixa Econômica Federal (CEF), Banco Nacional de Desenvolvimento Econômico e Social (BNDES); one private bank (Itau - the largest private bank in Brazil). From flow-of-funds indexes we could



illustrate the role of each institutional sector in the Brazilian financial system, we could highlight that the discrepancy of dispersion can be a good indicator to economic problems and the cause of recession origins both in the structure of financial system as well in the behavior of agents in objective economy.

Key-word: flow-of-funds, financial crisis, Brazilian economy, asset-liability-matrix, input-output.

## **Macro\_financial linkages of the Brazilian economy**

Topic: Feedback Session 5a

Author: Erika BURKOWSKI

Co-Authors: Fernanda Finotti Cordeiro Perobelli, Fernando Salgueiro Perobelli

This paper aims to identify the main paths through which financial shocks were transmitted to economic activity sectors in Brazilian economy during the crisis of 2009. We calculate the multiplier product (Leontief, 1941) applying the Miyazawa Expansion Factor (1976) on the financial flows of the Brazilian Financial and Social Accounting Matrix (FSAM). The Brazilian FSAM are available on Lates (UFJF, 2016) to the period 2005 to 2009. They present seven main groups of accounts: Production Account, Activities Account, Factors Account, Current Account, Capital Account, Financial Account and Rest of World Account. The accounts were detailed using the information from: Make and Uses Tables (TRU) published by the Regional Center of Economic Research (NEREUS/USP); the Integrated Economic Accounts (CEI) from the Brazilian Institute of Geography and Statistics (IBGE); and the Financial Account from IBGE and the Central Bank of Brazil. The multiplier determines the impact of exogenous variation of a currency in the financial intermediation sector, in the final product of the other sectors of economic activity and total output of the economy. We also decomposed the multiplier matrix into three parts: i) the total equilibrium from production, income and final demand transactions; ii) the total equilibrium when saving and fixed capital formation are considered; iii) the total equilibrium including financial account to complete the money flow in the economy. Preliminary results shows the total effect on the sector multiplier, 55% is caused by changes in production and income, 12% due to gross fixed capital formation and 21% due to financial flows.

## **Bridging macroeconomic data between classifications**

Topic: Micro data

Author: Mattia Cai

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In applied research and policy analysis work, it often becomes necessary to link datasets that adhere to different statistical classifications. Most commonly, this occurs as a result of the periodic revisions that industry and product classifications are subjected to. In the late 2000s, for example, the national accounts of European Union member states switched from revision 1.1 to revision 2 of the 'Statistical classification of economic activities in the European Community' (NACE, from the French acronym). When the boundaries of an industry shift, comparability over time is lost for important economic variables such as value added or employment. Then, obtaining consistent time series for the industry-level variables of interest requires conversion between classifications.

The need for reclassification, however, can also arise for other reasons. Sometimes, for instance, data need to be reorganized according to a classification other than that in which primary collection took place before they can be used as an input to a certain economic modeling

exercise of interest. Consider data on final use by households. In the supply and use framework, each transaction is categorized according to the characteristics of the good or service that is being exchanged. In a European context, this means that data on final use by households have to be organized according to the 'Statistical Classification of Products by Activity' (CPA). Household surveys, however, typically collect information about the purpose for which expenditures are made, and not about the type of goods or services that are acquired. These surveys usually adopt the 'Classification of individual consumption by purpose' (COICOP). Before the data can be incorporated in the IO framework, they must undergo conversion from COICOP to CPA.

In the context of their institutional activities, national statistical offices do construct conversion factors that allow bridging between classifications. That kind of information, however, is not typically released to the public. Furthermore, even when conversion factors are available, it is rarely the case that the degree of aggregation is aligned to the needs of the analyst. In practice, when it comes to classification issues, independent researchers are generally left to their own devices.

To the best of the author's knowledge, the academic literature provides little guidance as to how to handle data reclassification problems. Like other common data management tasks, classification issues are rarely discussed. By and large, it appears that in applied work practitioners predominantly use expert judgment to establish best-guess correspondences between aggregates of the source and target classifications. The process of specifying such correspondences is often tedious and its outcome somewhat subjective.

This paper describes a simple, mechanical and reproducible approach to the construction of bridge matrices under conditions of data availability that are likely to be met in most circumstances. From a practical standpoint, the essential requirement is that there exists an earlier or later time period - or a geographical area that is similar enough to the one of interest - for which the relevant economic variable can be observed in both the source and the target classification. Using this information, we estimate a contingency table that links the two classifications by means of bi-proportional scaling methods. Finally, data reclassification is carried out using conversion factors computed from that table.

Estimating an unknown matrix by proportionally scaling an initial guess - typically referred to as the seed or prior matrix - using known marginal totals is a routine practice in a variety of fields. In input-output economics, the procedure is known as RAS. What is challenging about the specific RAS application discussed here is that it is not obvious how to construct a plausible seed matrix. In the spirit of Lenzen et al. (2012) and Lenzen and Lundie (2012), a simple option would be to use a binary seed matrix based on a readily available qualitative table of correspondences between classifications. In fact, we argue that from the same table of correspondences a more informative prior matrix can be constructed just as easily. In a nutshell, the proposed seed matrix is compiled by counting the number of fundamental items (i.e. items defined at the most disaggregated level of the classification) that simultaneously contribute to a given pair of source-classification and target-classification aggregates.

We examine two case studies in which the conversion factors used by the statistical office are known and find that, in spite of its simplicity, the proposed approach yields encouraging results. We then try to assess the performance of the procedure in a more general context using Monte Carlo simulation.

## **The Matrix of Social Accounting (SAM) for analysis of the welfare Brazilian programs**

Topic: Welfare programs

Author: Ana Cristina Guimaraes Carneiro

Co-Authors: Dinilson Pedroza Junior

This article presents a matrix of social accounting (SAM) for Brazil. This is constructed using the 2010 input-output matrix (MIP), the demographic census of 2010, the integrated economic accounts (CEI), also of 2010 and the family budget survey (POF) of 2008-2009, all surveys conducted by IBGE, institute of official statistics from Brazil. A SAM aggregates economic and social information into the standard structure of a MIP. The MIP informs how the various sectors that make up an economy relate with each other. The input-output model, originally developed by Leontief, allows us to establish the degree of technical dependence among the various branches of activity of a national or regional economy. Such precision makes it possible to glimpse how an increase in demand for a particular sector has repercussions throughout the economy. SAM describes how wealth generated and allocated is distributed among social classes or income brackets. In detailing the household consumption structure, a SAM shows how the sectors of activity are impacted by variations in the income of each social class. The purpose of the SAM presented here is to investigate how a typical demand shock has repercussions throughout the economy, not only in terms of activities most affected, but also in relation to the income distribution pattern of the whole society. A proposed exercise in this work is to quantify the economic and social response to a more intense income distribution policy: a reduction of taxes for the wealthier classes is thus compared to an increase in the volume of welfare programs (such as example, Bolsa Família program, created by the Federal Government in 2004).

## **QUANTIFYING THE MARINE ECONOMY IN BRAZIL: THE BRAZILIAN MARINE INPUT-OUTPUT MATRIX**

Topic: Satellite accounts

Author: Andréa Bento Carvalho

Co-Authors: Gustavo Moraes

Studies of marine economy assessment have been increasingly carried out by nations that acknowledge its importance to the national economy. The concept of a marine economy and its quantification are important to change or to create appropriate public policies. Even Brazil displaying one of the longest coastlines in the world, there is no specific statistics data the sea contribution to the Brazilian economy. Regarding the Brazilian coastal dimension, in a total of 26 Brazilian states (except of Federal District) seventeen are located on the coast. These states comprise 280 cities, 13 state capitals and about 34 million inhabitants. The quantification of the marine economy in Brazil is innovative, since there is no information about it. Therefore, this paper aims to quantify the Brazilian marine economy for 2015 by estimating the National Input-Output Matrix which creates the marine sectors. The result of this work is the Brazilian Marine Economy Input-Output Matrix, denominated MIP Br Mar. In order to reach the objective, the methodology was Input-Output Model. Data for development the MIP Br. Mar have been obtained from official institutions of the Brazilian government. The Brazilian marine economy, for the year 2015, generated for the national economy R\$ 1.11 trillion of GDP and R\$ 1.18 trillion of GVA. The Brazilian marine sectors employed more than 19 million people. The final demand of the marine sectors was estimated at R\$ 1.3 trillion. Therefore, it should be noted that the Brazilian marine economy is dominated by the sector of services, where we can highlight tourism.

## **Demographic Changes and its Impacts on Consumption and Greenhouse Gas Emissions in Brazil: a computable general equilibrium model approach**

Topic: CGE & Demography

Author: Terciane Sabadini Carvalho

Co-Authors: Flaviane Souza Santiago, Fernando Salgueiro Perobelli

In recent years, the debate on issues related to demographic changes and their impacts on the economy has increased. However, demographic changes affect not only variables such as economic growth and the labor market, but also aggregate consumption, and especially the composition of this consumption. These changes in population composition may occur in the coming decades in many parts of the globe, and their effects on the composition of consumption, notably on energy demand and emissions are not yet known. In this context, this article aims to estimate the changes in the pattern of consumption in Brazil due to the changes projected in the age pyramid in 2050 and the consequences of these changes on CO<sub>2</sub> emissions. For this, projections will be made using a recursive dynamic computable general equilibrium model (CGE) considering 67 sectors and 6 age groups for the Brazilian economy. As far as we know, this is an unprecedented study for Brazil, being the first to attempt to evaluate the impact of the population aging on consumption patterns and CO<sub>2</sub> emissions. The dynamic CGE model can capture both the direct effects of this change, the indirect effects via inter-sectoral linkages and the substitution effects over time. Another advance of the research is to make the analysis more appropriate estimating different elasticities by age groups and sectors.

## **IMPACTS OF THE DOHA ROUND AND ECOWAS ON THE GUINEA-BISSAU ECONOMY: AN ANALYSIS WITH CGE MODEL**

Topic: Feedback Session 3a

Author: Júlio Vicente Cateia

Co-Authors: Mauricio Vaz Lobo Bittencourt, Terciane Sabadini Carvalho

Economic activity of Guinea-Bissau is fundamentally based on agricultural production, which accounts for more than 60% of its gross domestic product (GDP) and 90% of its exports. In the amount of 68% of the population over 15 years employed, 61% correspond to employment in the agricultural sector, 5.8% industrial, and 34.1% employment in the services sector.

Guinean government has adopted policies to promote the export of agricultural products, since customs revenues contribute significantly to the country's public finances. Customs revenues from exports contribute between 35% and 40% of total tax revenue generated since 2007.

However, trade in agricultural products depends heavily on how the world market works. However, until the 1990s, agricultural goods did not have their international trade regulated by the General Agreement on Tariffs and Trade (GATT). Agriculture became the focus of effective discussion only in the Doha Round in 2001. Thereafter discussions on the potential of tariff reduction agreements on welfare and on sustainable economic growth of nations highly dependent on the performance of the primary sector became more frequent.

Since the early 1960s, West African countries have started discussions on creating common market in which members decide to unify economic (monetary, fiscal, tariff, etc.) policies. This initiative resulted in the creation of the Economic Community of West African States (ECOWAS) in 1994.

Given the importance of the agricultural sector for the Guinean economy, this research seeks to deepen the understanding of how exports react to tariff reduction agreements. This analysis for a

small economy appears little in the empirical trade literature. The studies on the effects of tariff variation on economic performance reveal some limitations, since they are usually carried out under the partial equilibrium perspective, without many concerns about the possible spillovers for the other sectors that an economic policy is capable of provoking. Empirical work in a general equilibrium perspective is done in large economies or with some diversification in the productive structure.

In addition, the claim that international tariff reduction agreements are capable of promoting the domestic development of poor countries has been common, but, to our knowledge, no studies have been found for the purpose of analyzing the sensitivity of the sectors of this small economies, where agriculture is the main economic activity, to price shocks. The achievement of the our study through the application of a computable general equilibrium model can help to fill these theoretical and empirical gaps.

Understanding how the country's exports respond to tariff shocks can especially serve to guide the government in the elaboration of more consistent economic policies precisely in those sectors that have comparative advantages.

In view of this, the our paper begins with the following questions: How do the Doha Round and ECOWAS influence the volume of exports of agricultural products from Guinea-Bissau? Do these tariff reduction agreements together with domestic promoting agricultural production policy have any redistributive effect capable of promoting growth and poverty reduction? What are the mechanisms through which international trade affects the trajectory of income and investment of the sectors?

This study seeks to answer these and other questions with triple basic goals, namely: (i) to analyze the tariff reduction proposal formalized in the Doha agreement on the Guinean agricultural sector; (ii) to study the impact of ECOWAS on the Guinean economy; (iii) to contribute to the analysis of trade liberalization and development implications, particularly discussing the effects on poverty reduction and welfare improvement of trade tariff reductions and agricultural production incentive policies. This analysis will be based on the Guinea-Bissau economy-based computable general equilibrium (CGE) model with GAMS/GEMPACK based on the 2007 social accounting matrix (SAM). There are two simulation scenarios: a baseline scenario is taken with reference to the policies existing and another one is summed up considering the Doha agreement and the creation of ECOWAS.

It is assumed that such agreements may have the potential to provide a stable trajectory economic growth of Guinea-Bissau because, by encouraging agricultural exports, they may also represent an opportunity for greater external and domestic investments in sectors of the economy, and particularly in the agricultural sector, contributing to the reduction of poverty. In particular, in addition to its potential to increase domestic employment and boost regional trade, ECOWAS can benefit the population as it raises domestic wages as a result of improved wages throughout the region.

## **Economic impact assessment of alternative investment scenarios for pension funds in Mexico**

Topic: Investment and capital formation  
 Author: LILLIAN MARLEN CENTENO CRUZ  
 Co-Authors: Pilar CAMPOY-MUÑOZ

### **Abstract**

Nowadays, the pension system in Mexico does not fulfill the coverage rate aimed, resulting in the impoverishment of the retired population. This situation is expected to become worst due to

workers are not able to contribute enough to their own saving accounts within the current system. This paper contributes to the debate about pension system reforms by assessing alternative scenarios for the investment of fund raised. These scenarios are drawing based on the structural analysis of the Mexican for 2012, upon the corresponding Social Accounting Matrix. In doing this, standard and budget-constrained multipliers are calculated. Then, a linear CGE model is employed to carry out an economic impact assessment, enabling to determine those alternatives with outstanding outcomes in terms of production and employment.

## **Transition towards high share of renewables in Ukraine: linked energy system and CGE model approach**

Topic: CGE & energy-economy

Author: Maksym G. Chepeliev

Co-Authors: Oleksandr Diachuk

In this paper, we provide an assessment of low-emission development scenarios for the Ukrainian economy, which faces significant economic and environmental challenges. We use the soft-linkage of the energy system TIMES-Ukraine and Ukrainian computable general equilibrium models, which allows us to estimate an economy wide and environmental implications of long-term energy policies. Using such approach, we provide an assessment of the Ukrainian low-carbon development strategy initiative (ULCDS scenario, consistent with 2oC target), as well as analyze more ambitious long-term environmental target (RE scenario), which includes transition towards 92% share of renewables in gross final energy consumption by 2050 (consistent with 1.5oC target).

According to our results, further maintenance of the existing highly inefficient energy system in the long-run is even more expensive than transition towards 92% renewables share. As in case of Business as Usual (BaU) path, fuel expenditures account for almost 86% of total system costs and represent the most attractive “low hanging fruits” in terms of costs reduction. While both policy options show an improvement relative to the BaU path, only RE scenario provides sufficient national contribution in terms of limiting global warming well below 2oC. At the same time, key differences between ULCDS and RE scenarios, both in terms of policy measures and results, arise after 2035-2040, which enables the possibility of smooth transition from ULCDS to RE during this period.

With initially low level of energy efficiency in Ukraine, both low-emission development (LED) policies result in positive macroeconomic and sectoral effects, with better perspectives in case of RE scenario, which at the same time requires 3 times higher investments. According to our estimates, GDP may increase up to 7-10% by 2030 and 14-16% by 2050 in case of efficient implementation of LED policies. Households may also experience substantial real income growth – up to 13-15% by 2050. In this context, Ukraine benefits from double dividends under both policy options, while RE scenario also provides an economically acceptable way of going from relative to absolute decoupling.

At the same time, existing institutional environment and inefficient market framework can pose significant risks for ULCDS and especially RE policies implementation. Our study identifies three sets of issues and corresponding recommendations that policy makers should focus on. First, under the current energy policy set up there is an inconsistency between targets of different strategic energy documents (e.g. Energy Strategy, Low-carbon Development Strategy etc). Solution of this problem requires both changes in the energy strategic planning set up, as well as social and political consensus around key strategic targets. Second, a number of additional incentives should be implemented in order to enable efficient market transformation. They include measures towards efficient pricing of fossil fuels, in particular price signals for industrial

users (as today CO<sub>2</sub> is priced at 0.01 EUR per ton), as well as more transparent and market-oriented approach to residential consumers. The former one includes move from uniform to targeted subsidies and elimination of cross subsidization in the electricity sector. Finally, in terms of market structure transformation, Ukraine should move to competitive energy markets (in particular, fully implement Third Energy Package), as well as proceed with further integration to the ENTSO-E. Both these steps should be used to expand institutional capacity for ULCDS scenario implementation in the mid-term and smooth transition to the RE path in the long-run. On the methodological part, our paper complements existing literature on the top-down and bottom-up hybrid approach to the energy and environmental policies assessment, as we develop and implement the soft-linkage of the energy system TIMES-Ukraine model (bottom-up model) and dynamic computable general equilibrium model (top-down model). In terms of policy-related contribution, our study represent the first attempt to justify the possibilities of transition towards high share of renewables in Ukraine (92% in gross final energy consumption) consistent with the international community efforts on limiting global warming to below 1.5oC.

## **Climate change impacts on agriculture using improved multi-region input-output framework**

Topic: Land-use change and agriculture

Author: Maksym G. Chepeliev

Co-Authors: Angel H. AGUIAR

Agricultural sector plays a central role in the climate change adaptation and mitigation strategies. As it is one of the key global emitters of greenhouse gasses (GHGs), much effort has to be put in order to reduce its carbon footprint. At the same time, according to many studies, it is arguably the most vulnerable sector to face the impacts of global warming with both land and water availability, as well as yields productivity, being under pressure. One of the approaches that attempts to consistently cover the global interactions between climate-related adaptation and mitigation strategies in the agricultural sector is a multi-region input-output (MRIO) framework.

This study assess climate change impact on the agricultural sectors under different quantitative projections of the Shared Socioeconomic Pathways (SSP) database. To this end, we dramatically improve the agricultural representation of the Global Trade Analysis Project (GTAP) Data Base. This database can be considered an MRIO, which when reconciles its data inputs focuses on international datasets more than in the various Input-Output (IO) tables at its core.

Any MRIO framework usually faces several limitations mostly driven by data availability issues. These include both low regional coverage and insufficient level of agricultural sector disaggregation. Moreover, even if an IO table has the required level of sectoral representation, it may be outdated and thus in need for updates. Several approaches are applied to overcome these issues. In particular, the GTAP Data Base, which sectoral classification includes 12 agricultural and 8 processed food sectors for 121 countries and 20 aggregate regions, uses a two-step procedure.

First, a special agricultural and food IO table is developed. It is based on the set of IO tables from representative countries as well as Food and Agricultural Organization (FAO) data and is used to split up agricultural sectors and related activities in the IO tables that require disaggregation. Second, selected countries are subjected to an agricultural production targeting (APT). The purpose of this procedure is to update the IO tables to match the agricultural production targets mainly in Organisation for Economic Co-operation and Development (OECD) countries and some large agricultural producers (46 countries in total). Key data is sourced from the OECD database and provided by the Joint Research Center (JRC) for EU countries based on Eurostat data. While providing a valuable contribution to the GTAP Data Base development framework, the current

approach to the APT targeting has some limitations and potential for further improvements. First, following the OECD agricultural commodity classification, input data includes high share of unclassified/undistributed (non-MPS) commodities, which should later be distributed among agricultural sectors. According to 2011 data, an average share of the non-MPS commodities for 25 non-EU regions represented in OECD database was 27%. Second, while covering 46 regions (corresponding to the 70% of global agricultural output), the APT process used in latest available GTAP version 9 (released in 2015) still missed most developing countries and some major agricultural producers, like India. Finally, because the OECD data does not cover all agricultural commodities, some food commodities output are used to complement the dataset.

Such limitations of the agricultural sector representation in the GTAP MRIO potentially have a significant impact on the results of the climate change policy simulations, influencing both sectoral and regional distribution of outcomes. In an attempt to overcome these shortcomings and provide a more consistent assessment of climate change impacts on global agriculture, we develop an approach to APT values estimation, which is based on the FAO database and some additional data sources. 5-step approach used in our study allows to estimate the APT values for 133 regions of the GTAP MRIO.

The newly developed APT targets combined with the JRC-based agricultural data for EU countries are used to produce an alternative GTAP Data Base, which is used to explore the impacts of climate change on the global agriculture with a dynamic computable general equilibrium model. We show how and improvement of agricultural sector representation in the GTAP MRIO affects the results of the assessment of climate change impact on crop yields by countries and sectors. This paper hopes to contribute to the ongoing efforts on improving the representation of the agricultural sector in the MRIO framework by taking advantage of the international datasets. Utilizing the benefits of agricultural sector representation, our study also intends to extend the literature on the assessment of long-term climate change impacts on agriculture.

## **Water and Global Value Chain: A subsystem application to Brazil**

Topic: GVC Environment-Economy

Author: Leopoldo Costa Junior

The deindustrialization of developed countries has led to a shift in water use activities to developing countries without a similar reduction in consumption of manufactured goods in developed countries. The location of different stages of production in other countries with the objective of reducing costs (including environmental ones) has led to an increase in international trade regarding final goods and, in particular, intermediate inputs.

The objective of this paper is to analyse the use of water by production and consumption in Brazil from 1995 to 2009, using a multiregional input-output matrix in order to consider all water uses (blue, green and grey water) associated to value chains. Estimates were made using the World Input-Output Database (WIOD).

The methodology of the subsystems or vertically integrated sectors is used to quantify the total (direct and indirect) use of the different types of water by the Brazilian sectors and subsystems from 1995 to 2009, including the uses avoided/caused by the final and intermediate imports/exports. Next, structural decomposition analysis is applied to investigate the role of international trade in the evolution of total water use and the extent to which the change in composition of domestic production by industry (and the consequent change in water use) is due to changes in production and in consumption. In conclusion, it is shown how comparison between the use of the different types of water by sector and corresponding subsystem provides can be useful for evaluating the impacts of public policies on production and consumption in the management of water resources.



As far as our knowledge, this is the first application of subsystem analysis of water use avoided/caused by the production, consumption, and final and intermediate imports/exports and the first structural decomposition analysis to be undertaken with economic and environmental data from Brazil.

## **Brazilian Inflationary Dynamics from 2000 to 2009: A Multisector Approach**

Topic: Price modelling

Author: Leandro Gomes da Silva

Co-Authors: Fabio Neves Peracio de Freitas

This work aims to analyze, from a multisector point of view, the Brazilian inflationary process between 2000 and 2009 using the System of National Accounts. In order to do so, we present a structural decomposition analysis methodology to be applied to the Input-Output Price Model. Based on the assumption that under normal conditions of a market economy, inflation is mainly caused by the increase in production costs, we evaluate the results of the structural decomposition analysis for the Brazilian economy during the period 2001-2009. We divide the period in three phases. In the first, between 2001 and 2003, the major cause of Brazilian inflation is nominal exchange rate. The second one, from 2004 to 2005, marks a change in the path of the exchange rate, and an increase in the importance of commodities price and wages. In the last phase, from 2006 to 2009, labor cost exerts the most important influence on the inflation rate and due to the behavior of income distributive variables, the service sector became an important factor in the explanation of the inflation rate in the Brazilian economy. This work advances the application of structural decomposition analyses covering a new field, associated with the input-output price model, since this exercise is traditionally executed for the quantity model.

## **Vertical and Horizontal Specialization Revisited: Case of India**

Topic: Implications of GVCs

Author: Paramita DASGUPTA

Co-Authors: Kakali MUKHOPADHYAY

In the last few decades world production system has been changing rapidly where splitting up the production of a good into different stages of production across spatially dispersed locations on the basis of their comparative advantages has become a rising phenomenon. This phenomenon is widely referred to as “the fragmentation of production processes” or “Global Value Chains”. Trade involving production fragmentation has contributed to an increasing share of intra-industry trade (IIT) in manufactured goods and also that is mostly in the form of vertical IIT. Recent empirical researches have shown that vertical IIT not only reflects quality differences but also takes place due to vertical linkages in production resulting from international production fragmentation. After the adoption of trade liberalization measures in 1991 India’s IIT has grown in importance. Against this backdrop, the present paper attempts to measure India’s IIT and its various components like Horizontal IIT and Vertical IIT with some major trade partners, the USA, EU(27) and China during 2001-02 to 2015-16 and assess the country’s role in international production fragmentation. The paper also investigates how far India’s IIT contributes in inclusive growth by investigating its impact on employment considering various types of skills using Input-Output framework. This analysis is very pertinent for a highly unskilled labour-intensive country like India. The study also attempts to assess the impact of India’s IIT on environment

using IO technique and tries to find out whether India is a case of pollution haven in this regard. The study finds that share of IIT in total trade between India and its trade partners is increasing. India's IIT is dominated by the goods differentiated vertically (VIIT) which might be an indication of vertical specialization and increasing participation in global production network. However, India is found to be a pollution haven in case of IIT with EU(27) and the USA. Regarding employment generation, IIT has a positive impact on the labour market, particularly in trade with EU(27) and China. As India is found to be specialising mostly in lower-quality varieties which are unskilled labour intensive, promotion of IIT could lead to an inclusive growth in India.

## Energy and environmental studies: when to use which method of decomposition?

Topic: Drivers of energy consumption

Author: Paul de Boer

In many studies in the field of energy and environmental studies an aggregate change in a variable  $V$  is decomposed into a certain number of factors. It takes on two different forms: a multiplicative one ( $V^1W^0$ ), where the superscript 1 denotes the comparison period and the superscript 0 the base period, and an additive one ( $V^1 - V^0$ ).

This paper considers six widely used methods, all of them sharing the property of being 'ideal', i.e. they satisfy the requirements of 'time reversal' and 'factor reversal'. The latter property ensures that a unique solution is obtained. Five of them were already known in the field of index theory. The following table summarizes the names used in both fields.

Multiplicative		Additive	
Decomposition	Index	Decomposition	Indicator
SDA or generalized Fisher	Fisher	SDA or Sun-Shapley	Bennet
LMDI- I	Montgomery-Vartia	LMDI- I	Montgomery
LMDI- II	Sato-Vartia (S-V)	LMDI- II	Additive S-V

In a previous paper De Boer (2018) deals with the multiplicative and additive SDA decomposition; in terminology of index theory with 'Fisher' and 'Bennet'. He uses the generic formula of Siegel that generalizes the Fisher index, originally designed for the decomposition of total consumption expenditure into two factors (price and quantity), to the general case of  $n$  factors. By collecting duplicates the computation of the unweighted average of  $n!$  permutations ('elementary decompositions') is reduced to the computation of the weighted average of  $2^{(n-1)}$  combinations. Since both decompositions use the same combinations and weights one Matlab program, given in the paper, suffices to deal with both of them. In the illustrative example he deals with a decomposition of carbon dioxide emissions in the Netherlands into five factors so that the computation of 120 elementary decompositions is reduced to the computation of 16 combinations.

In this paper we apply the four LMDI methods to the very same example. We give one Matlab program that deals with these four methods at the same time. As expected, the methods for the multiplicative decomposition (Fisher, Montgomery-Vartia and Sato-Vartia) and the additive one (Bennet, Montgomery and Additive Sato-Vartia) yield similar results.

Based on theoretical and empirical arguments, we propose an answer to the question when to use which method.

Reference: De Boer (2018) Structural decomposition analysis when the number of factors is large: Siegel's generalized approach' written for presentation at the 9th Input-Output Workshop in Bremen (15-16 March 2018.)

## **THE IMPACT IN THE PRODUCTION CHAIN OF THE WOOD INDUSTRY OF THE AMAZON STATE: AN ANALYSIS OF INPUT-OUTPUT**

Topic: Satellite accounts

Author: Elane Conceição de Oliveira

Forestry production is a relevant economic sector for regional development. In the Amazon, activities in this sector are among the main sources of income for people living and working in the forest. This article looks at the impact on the lumber productive chain in the state of Amazonas from an external variation in the lumber product sector. The 2006 Table of Resources and Uses of the State of Amazonas was used. Once the TRU/AM was adjusted, it was possible to design a direct and indirect impact coefficient matrix and the final demand vector composition by activity on a scenario of lumber product export to the rest of the world. Results show that a final demand shock on lumber product exports increases the production of roundwood by 7.57% and 5.51% for production gross value and gross added value respectively. From this, it can be concluded that there is a positive and expressive impact on the production of roundwood in Amazonas due to changes in the wood transformation market, whether spontaneous or politically driven, which can put pressure in forest areas in the region.

## **THE ECONOMIC COST OF GENDER DISCRIMINATION IN THE BRAZILIAN LABOUR MARKET**

Topic: Gender and inequality

Author: Kenia B. DE SOUZA

Co-Authors: Edson Paulo Domingues, Geoffrey J.D. HEWINGS

Gender discrimination in the labor market can take several forms, creating wage differentials that are unrelated to productivity. The existence of these differences implies an economic cost for the economy in terms of production and labor income. In this article, these losses were estimated through the interaction of wage decomposition models and simulations with an input-output model. The wage decomposition was calculated at different points of the income distribution, using the recentered influence function (RIF) developed by Firpo et al. (2009). Using the results of the decomposition, it was possible to calculate individual wages adjustments, following steps proposed by Oaxaca and Ranson (2003), so that all individuals are remunerated according to their observable characteristics as well as the non-discriminated group. In turn, these estimates were used to compile two vectors of shock, for the simulation of rising nominal costs of labor, and consumption, considering households divided by income deciles. The wage decomposition model was estimated using the National Household Survey (from Portuguese PNAD - Pesquisa Nacional por Amostra de Domicílios) for 2013. The input-output matrix estimate was based on the supply and use tables for 2013, according to the procedures described in Guilhoto and Sesso Filho (2005) and the hypothesis of "industry-based" technology. The first simulation operates basically as the following: i) the adjustment was calculated at the individual level, ii) the change in sectorial labor cost depends on the total adjustment owed to all women working in that sector; iii) the increase in wages is incorporated as a rise in production cost, that causes expanding prices; iv) using Leontief price model assumptions, if the amount of money in the economy is the same, final demand is adjusted and the production falls; v) employment follows production. In the second simulation, it was assumed that the economy changed due to the first shock. Therefore, using the updated Leontief matrix, it was applied a second shock increasing consumption for all households, according to the income rise in each decile calculated at individual level and aggregated by income decile. Consequently, in the second simulation, consumption increases

production; and employment follows production. The simulation results indicate that the income effect generated through consumption overcomes the price effect, due to the wage rising in terms of production and welfare but not in terms of employment. Nonetheless, the results are very heterogeneous across sectors and households.

## **Sustainable consumption and population dynamics in Brazil**

Topic: Sustainable Development Goals

Author: Kenia B. DE SOUZA

Co-Authors: Edson Paulo Domingues, Aline Souza Magalhães, Flaviane Souza Santiago, DEBORA FREIRE

This paper analyses sustainable consumption in Brazil, highlighting the consumption profile of sustainable products by income level and household composition. We integrated the results from structural equation models (SEM) to a demographic scenario and a Computable General Equilibrium (CGE) model. The structural equation model was estimated from survey data from the Brazilian Ministry of the Environment, collected in 2012, designed specifically to understand attitude, knowledge, and behavior towards sustainable consumption. The SEM model provided results about pro-sustainable consumption attitude, pro-sustainable consumption behavior, supply constraints, effective sustainable consumption practices and organic consumption preferences in Brazil. Results were disaggregated by sex, age, and household income. While the SEM estimates provided a rich set of preferences for overall organic and sustainable consumption, it lacks the ability to quantify actual consumption of organic and certified products. To fill this gap, we used data from the 2008-2009 Brazilian Household Budget Survey. Actual consumption of both organic and certified products was stratified by income and household composition (age groups). While data from the latter survey allowed us to analyse how the pattern of organic consumption varies along income and household composition, the former survey provides us estimates of preferences. To estimate a future consumption scenario for Brazil and the impacts of changes in household consumption preferences towards organic products we employed a dynamic computable general equilibrium model. Household income growth, economic growth, population dynamics, productivity, and energy efficiency gains were explicitly modelled. A dynamic path for consumption preferences towards organic products was also included. Our simulation assumes that preference for organic consumption increases from 2016 to 2050, varying among income deciles. By 2050, Brazil would experience an overall increase in organic consumption, despite differences between poor and rich households regarding preference and share of income spent in organic products. This result is the consequence of the combined effect of income growth (faster for poorer households) and preference change (faster for richer households). The projected consumption path suggests that increase in organic consumption may generate positive effects for all households, including the poor, by increasing production, employment demand in sectors where the poor are more likely to be employed, and family income.

## **A Structural Decomposition Analysis of the Change in Global Renewable Energy Use between 1995-2009**

Topic: Structural decomposition

Author: Erik DIETZENBACHER

This study investigates the growth in global renewable energy (RE) use between 1995 and 2009. It identifies its main drivers and their geographical distribution. A structural decomposition analysis is applied to global multi-regional input-output tables and distinguishes six key drivers. Global RE use rose from 52.3 Exa Joules (EJ) in 1995, to 68.7EJ in 2009. This growth is not only caused by effects that are related to more energy use but is also increased due to the substitution of non-renewable to renewable energy. Our decomposition takes that substitution explicitly into account. The 16.4EJ increase was the net result of changes in: overall energy efficiency (-18.4EJ); consumption per capita (+26.3EJ); population (+10.3EJ); and the total (+1.6EJ) of the three remaining factors (including substitution towards RE and trade structure changes). The impact of trade on global RE use was negligible, but it played an important role in terms of relocation of RE use across countries.

## **Assessing the Impact of Fiscal Consolidations on Unemployment and Growth in the Brazilian Economy**

Topic: Multiplier & Linkages Regional

Author: Esther Dweck

Since the great recession of 2008/2009, the role of fiscal policy for both economic growth and income distribution has been back to the academic debate. The more expansionary fiscal policy in the aftermath of the crisis did not last long and, a few years after the crisis, several countries implemented large fiscal consolidations in response to the sudden increase on public debt. As a consequence, many of these countries have faced an increase in inequality and a depressed economic environment, which imposed even larger fiscal adjustments. In Brazil, since 2015, based on the same assumptions of the European case, the so-called expansionary austerity, a major fiscal consolidation was implemented with huge impact on unemployment and public finances. The results of this paper support the view of a self-defeating austerity. The decrease on public investment, imposed by expenditures cuts, has actually contributed to the economic downturn leading to a continuous decrease on tax revenues. In order to identify and quantify this phenomenon, in this paper we apply the same methodology presented for the Portuguese case in Amaral and Lopes (2015). We derived, based on input-output relations, an unemployment rate/budget balance trade-off equation, as well as the impact of a strong fiscal consolidation based on social transfers and the notion of neutral budget balance. The data used is a series of I-O and Fixed Capital Matrices valued at constant prices constructed by the GIC-UFRJ for the period 2000-2015. Besides the analysis of the current fiscal consolidation, we also try to simulate the consequences of the "New Fiscal Regime" with an emphasis on the expected impact of the expenditure ceilings on the trends of growth and income distribution. The paper confirms the huge costs of a strong and permanent fiscal consolidation, both in terms of unemployment and social policy regress.

## **The Impact of the Special Mining Tax After the Earthquake 2010 over key variables of the Chilean Economy**

Topic: Modeling the Chilean Economy to Analyze the Future of its Mining Sector

Author: juan pedro eberhard

Co-Authors: PATRICIO AROCA, Loreto Bieritz, Nicolas Garrido, Anett GROSSMANN, Anke M. MOENNIG

A severe earthquake occurred in Chile on February 27th of 2010. The magnitude of the damages created the political environment that allowed a change in the tax code and in particular an increase in a mining specific tax. The goal of the change was to increase government revenues and finance the reconstruction process. Copper is the main production in Chile and thus, this specific tax mainly applied to that aforementioned industry.

This paper studies the effect of this tax increase on investment, production, unemployment and other important aggregate economic variables. In particular, we focus our attention in the mining sector. We construct a dynamic input-output model for the Chilean economy. The model is estimated iteratively, and is constructed under a bottom-up philosophy on many sectors, with more precision than the standard 12 sector classification. We compare actual data from the period 2010-2015 with simulated data from the estimated model, adjusting the tax rate to introduce a counterfactual world, in which the taxes would have been the projection of the tax rate of the period 1996-2009, and therefore lower than the actual taxes. Comparing these two set of data, allow us to study the possible effects of the introduction of the new tax scheme in both aggregate and sectorial economic variables. The integration of input-output relations is a key feature of the model and it allow us to study not only the direct effect of the tax increase, but also how dissipates throughout the economy, and how it affected other sectors.

## **Using Virtual Laboratories for disaster analysis - A case study of Taiwan**

Topic: Disaster Analysis

Author: Futu FATURAY

Co-Authors: Ya-yen SUN, Arunima MALIK, Arne GESCHKE, Manfred LENZEN

Due to its geographic location, Taiwan frequently experiences severe natural disasters earthquakes and typhoons that significantly interrupt business operations and subsequently cause extensive financial losses. Currently, there is a lack of extensive and detail assessment of natural disasters in Taiwan, while its importance cannot be overemphasized due to the high occurrence rate, tremendous loss and high uncertainty. The importance to understand the inter-sectoral influences in the disaster context is especially critical. The direct loss is generally easily observed and the business is greatly subsidized by governments, while in contrast the indirect losses by sectors and by regions also require public assistances and policy attention, which can only be revealed through the equilibrium analysis. Hsu et al. 2013, for example, estimated the earthquake vulnerability of hi-tech manufacturing in Taiwan, however their study lacked the economic loss assessment resulting from supply-chain interruptions.

In this study, we reveal the direct and indirect value-added impacts resulting from four selected natural disasters in Taiwan: the 1999 Chichi earthquake, the 2016 Tainan earthquake, the 2009 typhoon Morakot, and the 2016 typhoon Megi. We conduct our assessment in the new TaiwanLab, a collaborative virtual laboratory that is capable of generating a time-series of sub-national multi-region input-output (MRIO) tables, capturing inter-regional transactions between 267

sectors across Taiwan's 22 cities-counties. We use the method proposed by Steenge and Bočkarjova 2007 to study post-disaster consumption possibilities resulting from four selected disasters that hit Taiwan between 1999 and 2016. This method requires as an input information about reductions in production resulting directly from a disaster, such as damages to public facilities, agriculture, manufacturing sites, and utilities. This information is assembled in the so-called event matrix that quantifies the relative loss in total output by specific region and sector.

Using the Taiwan MRIO database, we have revealed the economic impacts of four selected natural disasters in Taiwan, in particular resulting from business and public facility damages, as well as supply-chain interruptions – two areas that researchers found difficult to model in the past. The Taiwan MRIO database is able to serve as a fundamental model for disaster impact assessment. Through the understanding of regional economic distribution, sectoral contribution, and inter-regional supply-chain flow, the Taiwan MRIO database provides a comprehensive picture of Taiwan's regional economic structure, and how the interconnections within it expose it to natural disasters. We, therefore, are able to identify critical economic sectors in regions of high vulnerability to natural disasters. Our assessment provides a credible reference to decision-making in determining regional and sectoral prioritisation for damage prevention and economic recovery plans.

## **Mapping consumption impacts: combining IO models with consumption estimates for small areas**

Topic: Micro data

Author: Esteban FERNANDEZ-VAZQUEZ

Co-Authors: Mònica SERRANO

Household Surveys (HS) report consumption figures that can be used to calculate consumption impacts when used in combination with IO models, but the samples on which HS base are rarely representative to produce reliable estimates at a detailed (sub-regional) spatial scale. This implies that the use of IO analysis when quantifying the impacts derived of household consumption typically limits to estimate them at an aggregated regional or national scale. In this paper we apply an econometric procedure to estimate consumption figures at a highly disaggregated geographical scale, which would allow for calculating impacts of changes in the household consumption in particular sub-regional spatial units (i.e., cities, metropolitan areas or municipalities). First, we base in the methodology developed in Elbers et al. (2003) and Tazzoni and Deaton (2009), which predict spatially disaggregated economic indicators by combining data from HS's with the information contained in the Population Census (PC), since these datasets usually contain (non-economic) indicators observable at a highly detailed geographical classification. Then, a Generalized Maximum Entropy (GME) estimator is applied to adjust these initial estimates on consumption, making them consistent with the consumption aggregates reported on an IO table at industry level.

As an illustration, we study the micro-data of the Spanish Household Budget Survey and the Spanish Census of Population elaborated by the National Institute of Statistics (INE) in 2011. From these two databases we estimate consumption figures for more than 500 spatial units, which are subsequently adjusted to the consumption totals published in the Spanish IO table by applying a GME procedure. This estimation allows for identifying a considerable heterogeneity on the impacts derived of private consumption depending, not only on the administrative region, but also on the specific municipality within a given region.

## **Growth accounting in the age of global-value chains: A demand side perspective applied for Brazil in the period of 2000-2015**

Topic: Growth Accounting

Author: José Bruno Fevereiro

Co-Authors: Patieene Alves Passoni

Standard practices of demand side growth accounting in Economic Outlook Reports and other practitioner reports usually calculate contributions of demand components to growth based solely on growth rates of each expenditure component. This standard practice disregards the fact that imports are not a demand variable and, so, the individual contributions of the demand components in this method are not in fact contributions to economic growth (GDP), but contributions to growth of total supply and demand.

This issue is becoming increasingly problematic in times of global value chains. In this current context, the bulk of imports consists of intermediate goods that are embodied either in exports or in the supply of final goods demanded as consumption by households (or government) or as investment by firms. However, this observed increase in the import content in all final demand components is a very uneven process. As such, conventional methods of growth accounting may be producing increasingly distorted results and signalling inaccurate messages to the policy discussion.

We utilize I-O Matrices valued at constant prices constructed by the GIC-UFRJ for the period 2000-2015, based on information from the Brazilian SNA and I-O matrix official statistics. Import content coefficients are calculated to all final demand components, in similar fashion as it's done for exports in the trade in value added literature. As so, new estimates of contributions to growth from a demand perspective are calculated. Preliminary results for the 2000-2015 period reveals that contribution to growth of Investment is the most severely overestimated, revealing an average contribution to GDP growth much smaller than the one obtained with the use of conventional methodology. On the other hand, government consumption contribution is the least affected. The analysis developed with this framework is important as it enables a better understand of the demand sources of economic growth for Brazil in a context of internationalization of production.

## **EFFECTS OF TRADE BARRIERS ON BRAZILIAN SOYBEAN AND MEAT: The cases of China, EU and US embargoes**

Topic: CGE & Trade

Author: ADRIANO MARCOS RODRIGUES FIGUEIREDO

Co-Authors: Mayra Batista Bitencourt Fagundes, Leonardo Francisco Figueiredo Neto

The Brazilian trade flows have increased in recent years, even with high tariffs and nontariff trade barriers. This study questions: how changes in trade policies impact the Brazilian regions and the world? Liberal trade policies and trade agreements may favor some sectors more than others, independent of having gains to the overall Brazilian economy. On the other hand, trade barriers can adversely affect some sectors or regions. We evaluate the effects of the embargo imposed on Brazilian beef and soy. Specifically we analyze the regional trade in Brazil and its main indicators such as production, prices of commodities and factors, GDP, and welfare. The analytical model is based on a computable general equilibrium model called PAEG that allows the analysis of the Brazilian regions, their relationships with other countries or economic blocks, using the database



GTAP version 9. Input-Output matrices are at the core of the GTAP Data Base, and then to the GTAPinGAMS framework, which is used to build the General Equilibrium Model PAEG. The main features of the model are the disaggregation of the five Brazilian macro regions, with 19 activities and other 7 regions (Rest of Mercosur, USA, Rest of Nafta, Rest of Americas, European Union, China and Rest of the World). As Brazil and China have a significant trade, which differs among Brazilian regions, this addition to the GTAP 9 Data Base, 2011 base year, allows users to more easily use and adapt the model with GTAPinGAMS. The scenarios included a possible Chinese embargo on Brazilian grains and oilseeds; and a possible embargo from European Union (EU) or the United States (USA) (separately) over Brazilian animal products. The idea is to simulate a complete trade barrier in the selected product, say grains or animal products. The model is easier to implement simulating a tariff as high as the trade flow would disappear between Brazil and China, Brazil and the EU, Brazil and USA. The results show that the Chinese embargo on Brazilian soybeans would lead to a decrease in consumption of soybeans in China of about \$ 750 million. For regions in Brazil there was a reduction in exports (-USD 250 million) in the Midwest, but increased exports from the Southeast (USD 690 million), mainly of manufactured goods and clothing. As for the embargo by the EU and the U.S. Brazilian beef, shows that the impacts are smaller than those resulting from the Chinese embargo on Brazilian soybeans. The U.S. embargo would cause more damage than the European. The U.S. faced losses of welfare, making it more sensitive than the European Union in relation to Brazilian beef.

## **MANUFACTURED GOODS, MEATS AND GRAINS: ALTERNATIVES TO A BILATERAL AGREEMENT BETWEEN MERCOSUR AND CHINA**

Topic: CGE & Trade

Author: ADRIANO MARCOS RODRIGUES FIGUEIREDO

Co-Authors: Cláudio Eurico Seibert Fernandes da Silva, Mayra Batista Bitencourt Fagundes, Leonardo Francisco Figueiredo Neto

This study questions: what would be the economic impact of a bilateral agreement between MERCOSUR and China for the Brazilian macro-regions? The main hypothesis is that with the advent of this bilateral agreement the Brazilian agribusiness and the Chinese manufacturing sector would benefit. On the other hand, this agreement also can adversely affect some sectors or regions of these economies. This study aims to identify a possible bilateral agreement between Mercosur and China and their respective impacts on their economies. Specifically the goals are: a) to identify a possible preferential trade agreement between MERCOSUR and China; and b) to analyze the economic impacts in terms of GDP; household consumption; investments; public finances among other macroeconomic aggregates, arising from the proposed agreement. Input-Output matrices are at the core of the GTAP Data Base, and then to the GTAPinGAMS framework, which is used to build the General Equilibrium Model PAEG. The main features of the PAEG are the disaggregation of the five Brazilian macro regions, with 19 activities and other 7 regions (Rest of Mercosur, USA, Rest of Nafta, Rest of Americas, European Union, China and Rest of the World). As Brazil and China have a significant trade, which differs among Brazilian regions, this addition to the GTAP 9 Data Base, 2011 base year, allows users to more easily use and adapt the model with GTAPinGAMS. To this end, we used the General Equilibrium Model PAEG for conducting tariff reduction scenarios of 25%; 50% and 75% of the Mercosur agribusiness products such as soybeans and corn (OSD scenario) and meat (OAP scenario), together with the Chinese manufacturing sector (MAN scenario), with disaggregation in households into ten income tracts. We used a pay-off game matrix setting in order to detect the best tariff reduction scenario. The main results were that a tariff reduction scenario of 75% in the meat industry in Brazil and manufactured in China have the best results for the Brazilian economy, since the agreement (OAP

/ MAN) holds the highest GDP growth rate and reaches more positively industries. However, the best scenario for the Chinese economy was the agreement involving (OSD / MAN) Brazilian soybeans with the manufacturing sector in China, as it presented the best indices for the Chinese economy. China would have increase in consumption, government expenditures, exports, imports and GDP. Brazilian regions would in general gain in consumption, investment, exports, imports and GDP. The Brazilian regions' government expenditures would decrease, what can be seen as a good result either. It is detected that 47 from 50 Brazilian household income tracts would be better off with the agreement.

## **Recent Estimates of the Gross Fixed Capital Formation Matrix for the Brazilian Economy**

Topic: Databases for Multisectoral Analysis of the Brazilian Economy

Author: Fabio Neves Peracio de Freitas

Co-Authors: Thiago de Holanda Lima Miguez

The first contribution to the organized session "Databases for Multisectoral Analysis of the Brazilian Economy" addresses the methodology developed to and the data sources used in some recent estimations of the gross fixed capital formation (GFCF) by type of asset and by industry. The Industry and Competitiveness Research Group of the Federal University of Rio de Janeiro (GIC-UFRJ) estimated capital flow tables (CFT) for the Brazilian economy from 2000 to 2015, based on information from: the Brazilian SNA and I-O matrix official statistics (Brazilian Institute of Geography and Statistics - IBGE); the Commerce, Service, Construction, and Extractive and Manufacturing industries annual surveys (IBGE); the Brazilian National Development Bank credit lines (FINAME - BNDES); and the Brazilian external trade statistics (SECEX - Ministry of Industry, Foreign Trade and Services). CFTs are an important database for multisectoral analysis allowing, for instance, the dynamic modeling of an economic system, the capital stock estimation by asset and industry, the estimation of technological flow matrices and disaggregated analysis of GFCF. For each year from 2000 to 2015 there are imported, domestically produced and total (basic and consumer prices) CFTs valued at current and constant prices. We discuss the methodology developed and the data sources used in this estimation.

## **The Compilation of an official Gross Fixed Capital Formation Matrix for the Brazilian Economy: some methodological aspects**

Topic: Databases for Multisectoral Analysis of the Brazilian Economy

Author: Fabio Neves Peracio de Freitas

Co-Authors: KATIA NAMIR MACHADO BARROS

The second contribution to the organized session "Databases for Multisectoral Analysis of the Brazilian Economy" deals with some methodological aspects of the compilation of an official Capital Flow Table (CFT) for the Brazilian Economy. The compilation of this table is complex, involves the use of different databases as well as international recommendations within the framework of a System of National Accounts and, in most countries, is under the responsibility of the statistical institutes. The Brazilian statistical system can still advance with the production of CFTs. Among other things, these tables are essential for the sectoral analysis of investment in the Brazilian economy and can be used as a guideline for public policies. The Brazilian Institute of Geography and Statistics (IBGE) and the Industry and Competitiveness Research Group of the Federal University of Rio de Janeiro (GIC-UFRJ) established a technical cooperation agreement to

elaborate an official Capital Flow Table for the Brazilian economy. The former institution has a large experience in the elaboration of the Brazilian System of National Accounts, while the latter one possesses some previous experience in estimating CFTs for the Brazilian economy. In this session, we address some conceptual aspects of the CFTs estimation concerning the different types of fixed assets that composes the GFCF, the main methodological recommendations and the international experiences in the CFT construction.

## **The Input-Output Matrices of the Brazilian System of National Accounts: methodology and sources of information**

Topic: Databases for Multisectoral Analysis of the Brazilian Economy

Author: Fabio Neves Peracio de Freitas

Co-Authors: Cristiano de Almeida Martins

The third contribution to the organized session “Databases for Multisectoral Analysis of the Brazilian Economy” discusses the methodology and the data sources used in the compilation of Brazilian Input-Output Matrix for the year of 2015 (to be released in August 2018). The Brazilian Institute of Geography and Statistics (IBGE) initiated the estimation of Input-Output matrices in the 1970s and it maintains a regular production of quinquennial matrices at the national level beginning in 1980. Currently, the construction of these matrices is based on the Supply and Use Tables from the Brazilian System of National Accounts (SNA) and involves both the use of data produced by IBGE itself and the use of external sources of information. The main data structures, built from the IBGE's surveys, are the breakdown of the industrial production based on the Annual Extractive and Manufacturing industries Survey, the estimation of trade and transportation margins rates based, respectively, the Annual Survey of Commerce and the Annual Survey of Services, and the detailing of the intermediate consumption constructed from the Intermediate Consumption Survey. The preparation of Input-Output matrices also involves additional work to validate the data, in particular, the origin (national or imported) of the products consumed in each activity

## **The Impact of Decrease of Wheat Self-sufficiency Rate----Based on Input-output Price Model**

Topic: Price modelling

Author: Man man Fu

Abstract: China is a country with the largest grain demand in the world, but at present China is facing growing difficulties in increasing grain output. The current high self-sufficiency in grain may cause large pressure on resources and environment. Wheat is the main grain of China, is it possible for China to import more wheat? How much will it affect the world economy if China imports more wheat? This paper proposes a method to measure the short-term impact of China's sudden increase of wheat import and the long-term impact of the world capacity when China's grain self-sufficiency rate reduces. For the short-term impact, this paper conducts empirical analysis under the scenario that the self-sufficiency rate of wheat in 2014 suddenly drops by 5 percentage points. Firstly, we calculate the changes of wheat price by price elasticity of import due to China's sudden increase of wheat imports. Secondly, based on the data of WIOD, we use the input-output price model to calculate the impact of drop in self-sufficiency rate of wheat on China and relevant economies in terms of price. Finally, by using input-output model, we calculate the increase of world input in order to adapt to the more import of China in the long run.

In general, the decrease of China's self-sufficiency rate does not affect much on the world economy, but it is different across economies and sectors.

Key words: Wheat import; Wheat prices; Self-sufficiency rate of Wheat; Input-output Price Model

## **The approach of the national I-O submodel**

Topic: Subnational tables

Author: Viorel Nicolae Gaftea

Co-Authors: Emilian Dobrescu

The Input-Output modeling approach is based on the Romanian I-O Tables 1989-2015. The conceptual and analytical cadre of the I-O approach for a national macro model uses the behavioral analysis and support estimations equations for technical coefficients, macro indicators and other variables. The paper deals with the needed operation to design and use, the synergies between econometric and accounting relationships, the integration of regional I-O sub models needed to address the economy as a whole model. The model describes the structure and the potential of the national economy, allow for achieving a solution that offers the best picture of the economy, enables strong and varied research modeling and forecasting capabilities and confirm the antiques advantages of the models based on I-O analysis. The basic structure of the necessary sub model can be defined in terms of the influence and role of the main macro indicators and determine the priority economic changes. Investment, household final consumption, domestic demand for goods and services and export demand, are elements that contribute to general equilibrium in the model. Regional Gross Domestic Product (RGDP) is calculated for the four macro regions divided into eight development regions and one extra-regional. We present an aggregation for the regional model specific to I-O analysis. Answering to this main policy analysis, the central model provides coverage of economic and functional requirements for a minimum national model. We detail the theoretical and practical approach for several other sub models also based on data structures of 'input-output' tables.

## **Measuring the Generalized Global Industry Relocation - Based on World Input-Output Model**

Topic: Implications of GVCs

Author: Xiang Gao

SPECIAL SESSION on "Implications of Global Value Chain"

Session organizer: Kakali Mukhopadhyay, Professor, Gokhale Institute of Politics and Economics, Pune-411004, India

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Abstract:

The financial crisis in 2008 prompted the restructuring of the world economic and trade pattern. The global value chain began to restructure, and global industry relocation presented more diversified features. Therefore, the researches on the measurement and mechanism of industry

relocation become increasingly important. This paper put forward a new approach to measuring the value of generalized industry relocation based on world input-output model. In the approach, we subdivided the generalized industry relocation into industry relocation driven by intermediate inputs, by final products, and indirect intermediate industry relocation driven by final products industry relocation. In the empirical part, this paper first used the new-released WIOD world input-output tables to measuring the value of generalized industry relocation during the periods 2000-2007 and 2007-2014. The results revealed the features about industry relocation in these two periods, some of which are consistent over time, such as the global industry relocation obey the Pareto Principle; the others present the heterogeneity between these two periods, for example the industry relocation of India and Germany. Furthermore, this paper focused on the global manufacture relocation. The results reveal that, in 2000-2007, the features of manufacture relocation of China and Brazil were similar; in 2007-2014, there were some similarities between China and India.

## **From Startup to Scale-up: An approach to Andalusian high growth companies through the Social Accounting Matrices**

Topic: Feedback Session 1a

Author: Joaquin Garcia-Tapial Arregui

Co-Authors: Manuel A. CARDENETE

Much has been written in recent years about entrepreneurship and its role as an engine of economic activity. However, in recent months, public authorities are increasingly focusing on so-called scale-ups, referring with this term to start-ups that experience growth greater than 20% for at least three consecutive years. The general belief is that these companies have a big impact on the economy, especially in terms of job creation, and therefore, in an environment of scarce public resources, the big question is whether to continue devoting public resources to the generation of new ventures, or if these should be directed to the promotion of scale-ups. For this reason, the effect of the entrepreneurial activity in the region and of this type of newly created companies on the regional Andalusian economy and its impact on it has been compared with the effect it would have if instead of creating new companies, existing ones would be scaled. In order to do this, we have developed a multisectoral model, based on Social Accounting Matrices, to measure this impact. The results obtained show that, in absolute terms, scale-ups have a greater impact on the gross domestic product, productive output and job creation than traditional entrepreneurial activity.

## **Analysis of economic impacts in the Metropolitan Area of Mexico City, through the construction of a Multiregional Input-Output Matrix, a bottom-up spatial approach.**

Topic: Regional & spatial

Author: Karina GARDUÑO

Co-Authors: Marcos N. MAYA

The Metropolitan Area of Mexico City (MAMC) is located in the Central Region of Mexico, which it is the most important in the country, by agglomerating more than 30% of the value added and employment over the national total. At the same time, the Central Region owes its importance to the MAMC, since it concentrates more than 70% of its economic activity. In recent years, the productive structure of Mexico City has experienced a decline in industrial activity, while

increasing the importance of the services sector.

The multiregional input-output model allows the measurement of economic interdependencies in different areas of study, as well as the analysis of impacts and structural composition in the zones. Through a bottom-up spatial approach, it is possible to understand the dynamics of urban economies as sites that trigger growth. However, it is necessary to consider that the construction of regional matrices poses problems associated with the availability of economic information at the local level.

Hence, the research question is: What are the main economic impacts in the Metropolitan Area of Mexico City? The proposed methodology consists of: 1. Identification of local nodes and their areas of influence within the MAMC (subregions); 2. Data collection and estimation of missing regional variables in the study area; 3. Construction of the multiregional input-product matrix for the Metropolitan Area of Mexico City; 4. Measurement of economic impacts and structural analysis in the different areas of influence. The data to be used comes from the sources of official information, specifically Economic Census and Population and Housing Censuses.

Thus, this research constitutes a leap in the assembly of multiregional input-output matrices at the city level, which it has a novelty: the identification of local nodes and their functional areas of influence, which database is elaborated from a bottom-up spatial approach.

Keywords: local nodes, subregion, multiregional input-output matrix, metropolitan area.

## **Impact Assessment of the Changes in the Energy Sources on the Chilean Mining Sector**

Topic: Modeling the Chilean Economy to Analyze the Future of its Mining Sector

Author: Nicolas Garrido

Co-Authors: PATRICIO AROCA, Loreto Bieritz, Juan Pedro Eberhard, Anett Grossmann, Anke M. Moennig

Chile's economy is heavily dependent on the copper mining sector. The mining sector, in its production process, requires large amounts of energy consumption. Therefore, all the variations that occur in the energy sector have important effects on the economy of Chile.

This paper will analyze the combined effects that the transformation of the energy sector and the aging of mining deposits produce on the gross domestic product and the aggregate and sectoral distribution of employment in the economy of Chile.

On the one hand, since the beginning of the 20th century, the government has embarked on a profound process of renewal of the energy matrix, which in recent years has focused on increasing the share of non-conventional renewable energy production. In this framework, investments in the energy sector are making Chile one of the leading countries in the consumption and production of so-called clean energy. Additionally, during 2017 and 2018 the energy transmission system throughout the country has been integrated, increasing the sector's competition.

On the other hand, the copper mining sector is suffering an aging process, which leads to a lower proportion of copper in the deposits, and an increase in production costs. According to Cochilco, which is the state agency that advises the government in the mining sector, in the period 2001-2013 production has remained relatively stable, while energy consumption has increased at a rate of 4.3% per year.

## **Tracking the Sustainable Development Goals with Input-Output Analysis: A commentary and example**

Topic: Sustainable Development Goals

Author: Jorge Esteban Gomez-Paredes

Co-Authors: Arunima MALIK

In September of 2015, 193 member states of the United Nations adopted the “2030 Agenda for Sustainable Development”, which introduces 17 Sustainable Development Goals (SDGs) with 169 targets as the new organizing principles to direct global action towards a universal sustainable development path. Implementing mechanisms to track progress towards these global goals is still a challenge. Furthermore, the consideration of countries’ “spillover effects”, namely the positive or negative effect of a country’s actions onto others is just being discussed and considered for national performance assessments in terms of the SDGs.

As a general research question, this article explores the applicability of Multi-Regional Input-Output analysis for tracking performance towards the SDGs, including the consideration of spillover effects. To do so, and more specifically, the article sets to a) address the question: What is the current global scenario regarding the assessment of performance towards the SDGs in which a tool such as MRIO analysis can fill a particular niche, considering both its strengths and limitations? b) address the question: To what extent relevant existing works in the Input–Output literature have examined issues matching any of the 232 SDG-indicators proposed by the IAEG-SDG? Here, a 3-point classification scale is introduced: Class I = same as indicator, class II = relevant to indicator (could match the indicator with some modifications), class III = proxy related to the spirit of the corresponding SDG target (but not matching any of the target’s indicators); c) How can spillovers based on MRIO analysis be factored in performance evaluations and what are the implications of such country interactions? This, also considering the observation that SDGs’ targets can interact positively or negatively (Nilsson et al., 2016); d) develop an exercise to build on the previous points, using selected countries and socio-economic and environmental data from the Eora MRIO database. Based on all of this, some conclusions are drawn and aspects for further research are suggested.

This study combines a literature review and a MRIOA exercise using the Eora MRIO database, version 199.82, which includes more than 15,000 transactions between industrial sectors in 189 countries.

While there have been suggestions about the feasibility to connect MRIOA and the SDG (e.g., Xiao et al., 2017), greater deliberation is appropriate and several questions and implications need further consideration. This work sets the stage for such discussion and advances the examination of the potential that this macroeconomic analytical tool has for this new and timely application for sustainable development.

Keywords: Agenda 2030, environmental footprints, multi-regional input-output analysis, social footprints, spillover effects, sustainable development goals.

## **Estimation of Interregional Systems, is the Method Important? Comparing Brazil's TUPI and IIOAS Approaches**

Topic: Subnational tables

Author: Carlos Alberto Gonçalves Junior

Co-Authors: Joaquim J.M. GUILHOTO

Due to the lack of information, the construction of interregional input-output systems is usually carried out in a hybrid way, combining information obtained from survey with non-survey techniques. The diversity of non-survey techniques and the different ways of combining them may lead to the estimation of different interregional input-output systems for the same set of regions. In view of the above, the objective of this paper is to identify how the choice between different methods to estimate interregional systems may influence the results and policy analysis derived from them. Therefore, the present paper describes in details two different methodologies developed to estimate a interregional system for the 27 states of the Brazilian economy, the TUPI (Guilhoto et al, 2017) and the of IIOAS (Haddad et al 2017); subsequently, the interregional systems estimated from the IIOAS and the TUPI are compared in order to identify the main differences existing in holistic and partitive terms. The results show that, despite significant differences, mainly in partitive terms, in general the choice between the two methods does not compromise the overall results of the input-output analysis. However, for specific studies that involve a particular industry or region the analyst must be aware that possible differences may arise, as they are pointed out in the paper.

## **The Role of Services in Changing GVC Structure: Facts from OECD's ICIO**

Topic:

Author: Dong GUO

Co-Authors: Joaquim J.M. GUILHOTO, Norihiko YAMANO

Global Value Chain (GVC) has been the main trend of manufacturing function in the world in the last decades. While much literature has been contributing in different perspective on measuring GVC in trade in value added; how service promotes and is interconnect with GVC has not been paid the attention as it deserves. Services have been playing different roles in the different stages of production: a) in sectors like manufacture of computers, smartphones, electronics, printing, reproduction of recorded media, and manufacture of motor vehicles, services have an important role in concinving and developing these goods in more developed countries while the production is fragmented all over the world; b) at the latestes stage of production, i.e., consumption at retail store, the retail margin, transportation and electricity services are supporting the activity of household consumption; additionally c) the manufacturing productivity has impacts in the tradable services competiveness, e.g. business consultation, information and R-D and vice versa (services productivity on manufacturing competiveness) across developing and developed economies; and as a consequence d) differences in competiveness and productivity can be major in measures, like labor wage, labor productivity, gross revealed comparative advantage (RCA), etc. By using OECD's Inter-Country Input-Output (ICIO) database this paper will aim to contribute to a better understanding of how services by promoting GVC are at the same time changing the structure of GVC and trade in both, goods and service.



## **The Evolution and New Development of the US Input-output Accounts**

Topic: SUT compilation: experiences from NSOs

Author: Jiemin GUO

Co-Authors: Thomas F Howells

### **Abstract**

The mission of the Bureau of Economic Analysis (BEA) is to promote a better understanding of the U.S. economy by providing timely, relevant, and accurate economic accounts. The input-output (I-O) accounts are an integral and essential element of the U.S. economic accounts. Since the publication of the 1972 I-O benchmark when BEA instituted a major break from past I-O conventions in conformance with the 1968 SNA guidelines, by adopting the I-O framework of the “make” and “use” tables and changed the accounting method for secondary products, BEA’s I-O accounts has experienced some series improvements in the last four decades. This includes the integration with BEA’s NIPAs accounts, producing cohesive timely annual I-O accounts, moving towards the SNA framework through releasing Supply-Use Tables (SUT), and more recent work on compiling extended SUTs for measuring Global Value Chains (GVCs). This research provides the roadmap of BEA’s I-O accounts changes, focusing on the recent methodology development of US symmetric Input-output Tables (IOT) and its applications.

## **BEA’s International Collaborations on Measuring Global Value Chains**

Topic: Management of Globalisation in the National Accounts and Implications for Input-Output Tables and Analyses

Author: Jiemin GUO

Co-Authors: Thomas F Howells, Erich H STRASSNER

### **Abstract**

In response to the growing demands of measuring global value chains (GVCs) under supply-use table framework, BEA recently compiled a series supply-use tables while participating two international GVCs projects. The research offers the highlights of BEA’s activities in SUTs compilation for the United States, as well as the efforts in leading the APEC and North America TiVA initiatives in constructing two international supply-use systems. It outlines the work progresses, the technical challenges, and achievements of the projects.

## **The Grand Tour: Keynes and Goodwin go to Greece**

Topic: Structural decomposition

Author: Eduardo Amaral Haddad

The impact of the crisis in the Greek economy was not uniform among the regions, threatening socioeconomic cohesion. In this paper, we explore the concept of the income multiplier in a multi-regional setting, in the context of the Greek recession, showing empirical evidence for the increasing magnitude of the multiplier during the recession period. We present some basic information on the uneven regional impacts of the Greek crisis to motivate further our case study. We use a unique database comprised of two fully specified interregional input-output tables for Greece, estimated for the years 2010 and 2013. Despite some difficulties associated with the

process of estimation of the database that generate some caveats in the analysis, we provide some insights to be further explored in future studies. What has happened to the national income multiplier during this period? Have Greek regions adjusted in different ways with implications for the changing value of their respective multipliers, and, consequently, for the design of countercyclical regional policy prescriptions? Using techniques of structural decomposition analysis (SDA) for comparing different economic structures in the context of partitioned input-output systems, we are able to assess the main driving forces of the changes faced by the Greek regions in the first years of the economic recession and fiscal austerity. We show that changes in final demand - mainly in investment and government demand - were the main drivers of the setback of the economy. However, technical change was also an important element to drive changes in regional income. In spite of its smaller magnitude, it has played different roles for different regions. While in some regions technical coefficients have adjusted through stronger internal linkages that favoured the internalization of the multiplier effects, other regions increased their dependence upon the rest of the system, increasing the existing leakages. Overall, the national income multiplier for Greece increased by 5.9% from 2010 to 2013. Moreover, all regions also faced increases in their value added (income) multipliers during the recession period, notwithstanding differences in the intensity and in the spatial distribution of the changes. The main results reveal a complex system of interregional relations on some of whose structural characteristics the cyclical reaction paths of the regions depends. In this case, the use of fiscal instruments to stimulate local activity in the regions may bring about important implications for regional inequality in Greece.

## **Evaluating Income-Specific Carbon Footprints of Household Consumption for Assessing Carbon Tax Policies: A Case Study of Germany**

Topic: Sustainable production and consumption

Author: Gilang Hardadi

Co-Authors: Alexander Buchholz, Stefan Pauliuk

Household consumption is an important engine of the economy, but increasing household demand pressurizes the environment due to its linkage to greenhouse gas emissions (GHG) and resource depletion. Policymakers are seeking to administer policies to minimize environmental pressures without hurting the domestic economy, and one of them is the implementation of a carbon tax. This study is conducted to provide policymakers with insight for developing carbon tax policies that are rightly-targeted to protect low-income households, using Germany as a case study.

EIO-tables have become widely used because of their ability to quantify national GHG emissions based on individual products and industries. In this study, an MRIO-model was used to calculate carbon footprint (CF) of German households specifically for 12 different income brackets. EXIOBASE2 and a Consumer Expenditure Survey (CES) in 2013 functioned as the data basis of the model. The income-specific CF information was then used to simulate scenarios of global-level carbon tax.

The breakdown of income-specific CF into the 17 different industrial sectors showed that groups with higher per capita income showed a relatively high share of CF in transportation (16.3% of the total CF, compared to 9.6% for low-income), manufactured goods (33.6%, compared to 13.6%), and retail trade (16.8%, compared to 9.8%), while CF of lower income groups was dominated by basic needs, e.g. electricity (52.9%, compared to 19.1% for high-income). The

share of direct household emissions (scope 1) and value chain emissions (scope 3) increased along with increasing per capita income from 17.5% up to 33.2% for scope 1 and from 42.4% to 57.4% for scope 3, while the share of emissions caused by the use of energy (scope 2) decreased from 39.8% to 9.4% since absolute emissions from electricity were relatively unchanged among different income groups.

The average CF per capita of Germany was 11.4 ton CO<sub>2</sub> eq. The increase of footprint per capita due to the increase in per capita income is generally insignificant, although a noticeable increment happened within the three highest income groups; from second-highest (15.3 ton) to the highest income group (19.2 ton) and from third-highest (12.4 ton) to the second-highest, compared to CF increase from fourth-highest (11.3 ton) to the third-highest. CF per Euro increased from the lowest income groups (0.66 kg/EUR) to the mid-income groups (0.78 kg/EUR), yet increased marginally at the highest income groups (0.81 kg/EUR).

The slight increase of footprint per Euro from the mid-income to the highest income groups was a result of the higher-income groups also increasing their consumption of low-carbon sectors while low-income groups spent most of their income to consume carbon-intensive basic necessities. This shift in consumption could result in a socially-unjust carbon tax implementation, where prices of carbon-intensive products would go up under the implementation of non-targeted carbon tax. This study illustrated the possibility of carbon tax implementation that aims to reduce overall footprint while ensuring basic welfare, where carbon tax is assigned to the consumption of petroleum and petrochemical products, trade of motor vehicles, and non-public transportation.

## **Profiling Multinational Corporations in Australia and the Impacts on the Australian National Accounts**

Topic: Management of Globalisation in the National Accounts and Implications for Input-Output Tables and Analyses

Author: Khanh Vy Hoang

In order to produce the expected suite of economic statistics, national statistical offices need to maintain registers of statistical units on both a production and an ownership (institutional units) basis. The Australian Bureau of Statistics (ABS) has a dedicated program that profiles large complex firms. This paper discusses practices that occur in the profiling program and how the national accounts through the Supply and Use framework provides further consolidation to ensure accuracy within the National Accounts. The paper then gives practical examples of how the ABS profiles multinational, large and complex organizations within the manufacturing and online content streaming industries before concluding with a discussion of the benefits of consolidating their data within a supply-use framework.

## **Constructing Supply and use tables in current and constant prices: the Australian experience**

Topic: SUT compilation: experiences from NSOs

Author: Khanh Vy Hoang

In Australia, the compilation of Input-Output tables as part of national accounts go back to the sixties. From 1998 onwards, the Australian Bureau of Statistics (ABS) set up a new integrated system, based on supply and use tables in both current and constant prices. The introduction of

supply and use tables has improved the quality of the national accounts as well as the IOTs estimates. The main reason for this change is that the supply and use provide a superior integration framework. They provide a closer link with source statistics such as on production and foreign trade statistics, data on capital and consumption formation and maybe even more important, with prices statistics. This paper provides an overview of how the ABS construct supply and use tables in current and constant prices and discusses some of the challenges in the construction of these tables.

## **A new frontier in environmental input-output analysis: Corporate Sustainability/SDG Assessment**

Topic: Sustainable Development Goals

Author: Rutger HOEKSTRA

Since the end of the 1990s, environmental input-output analysis (EIO) has grown from strength to strength in academia: the default method for footprints analysis is now EIO, the IPCC discusses consumption-based emissions and EIO publications are now published in the top journals. The availability of MRIO databases that include environmental data has enhanced this trend even further. But EIO is not only useful for analysis of environmental pressures at the national level. It is also increasingly being used in sustainability assessment for companies and other organisations. This paper will provide an overview of the ways in which EIO is used in a corporate setting. Furthermore, it discusses to what extent it competes or strengthens common approaches such as Life Cycle Analysis (LCA). Finally, this paper will argue how EIO might become more relevant in the field of Corporate Sustainability companies in future, especially in light of the Sustainable Development Goals (SDGs).

## **An Input-Output Study of the China Information Sector**

Topic: Multiplier & Linkages Investment

Author: Yongming HUANG

Co-Authors: Xiaofei Chen, JAMAL KHAN

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

## **An Economic Analysis of Salmonella Detection in Fresh Produce, Poultry, and Eggs Using Whole Genome Sequencing Technology in Canada**

Topic: Disaster Analysis

Author: Sonali Jain

Co-Authors: Kakali MUKHOPADHYAY, PAUL J. THOMASSIN

Foodborne illnesses cause a significant socio-economic burden worldwide. Nontyphoidal Salmonella is one of the major foodborne disease agents in Canada. To date, there is hardly any research on the cost and benefits of Whole Genome Sequencing (WGS) compared to the traditional technology (PFGE) for the detection of Salmonella from specific food products and the macroeconomic impact of the improved technology in outbreak detection. The current study is an attempt to make a contribution in this direction. The study estimates the annual costs of Salmonella from fresh produce, poultry and eggs in Canada and the economic benefits from the introduction of WGS in the detection of Salmonella clusters and outbreaks. The results from the cost-benefit analysis (microeconomic analysis) are then used to measure the impact on macroeconomic variables like industrial output, gross domestic product (GDP) and employment. Cost-of-illness and Health Adjusted Quality Life Years are used to estimate the monetary and non-monetary costs of Salmonella respectively. Probability models are used to account for uncertainty in the cost-of-illness estimates. The input-output framework is used to measure the macroeconomic impact. The macroeconomic impact is based on Canadian Supply-Use tables have been . To account for uncertainty of the net benefits from WGS three scenarios have been estimated based on the reduction in total illnesses and reduction in reported and unreported cases. Further, to estimate the macroeconomic impact of changes in the economy due to the introduction of advanced WGS. Four scenarios are exercised using the input output framework: i) productivity improvement, ii) decrease in direct healthcare cost, iii) decrease in federal cost and iv) total net benefits from WGS. The estimated number of Salmonellosis cases are 47,082 annually, which represents a cost of \$287.78 million from the traditional method- PFGE. The non-monetary estimates from PFGE are 529.20 years (Disability Adjusted Life Years) and 289.90 years (Quality Adjusted Life Years), annually. The total net benefits from the introduction of WGS ranges from \$64.98-\$90.25 million for total cases of illnesses (in 2013 CAD) and \$5.21 million for reported cases of illnesses. These net benefits are then used to measure the macroeconomic impacts of WGS. Positive net benefits from WGS, for total cases of illnesses, lead to increased industrial output (ranging from \$1.16-\$26.73 million), GDP (\$126.46-\$390.32 thousand) and employment generation (58-132). Overall, WGS will help in reducing the economic burden from Salmonella. In this regard, the study has offered some potential policies implications. The monetary savings from the reduction in direct health care cost and laboratory costs due to WGS can be invested in further research and development. A proper intervention of federal and provincial government is required, however. Finally, a holistic approach is essential for food safety which will improve the benefits from WGS in outbreak containment.

## **It takes two to tango. Dichotomous principles in regional economic models**

Topic: Multiplier & Linkages Regional

Author: Nino Javakhishvili-Larsen

Co-Authors: Bjarne Hartz Madsen

Macroeconomic models are filled with the dichotomous principles. It takes at least two factors to grasp the complexity of the ongoing processes in economy. Different types of macroeconomic models are built on two main principles, such as, quantity and price model, or static and dynamic model, or economic and demographic model. Regional economic models further integrate the spatial dimension, where the principles are also dichotomous, such as, origin and destination, or intra- and interregional. This paper attempts to explain regional impacts of export jobs by revisiting regional economic and Miyazawa's extended demographic model developed for the Danish municipalities.

The paper commences with the Leontief and Miyazawa formulations of the Interrelational Income Multiplier Model, which is decomposed into sub-components using the general interregional economic quantity model based upon the so-called two-by-two-by-two principle. This principle incorporates a number of conceptual and theoretical changes, which have become necessary as economies become more diverse and differentiated. There is a need to integrate essentially sub-regional and local/urban activities covering such areas as commuting, shopping, tourism and trade into a general interregional modeling framework. The theoretical changes examined include a set of new geographical concepts and in the context of an interregional SAM the development of the two-by-two-by-two approach involve two sets of actors (production units and institutions / households), two types of markets (commodities and factors) and two locations (origin and destination). The equations of the general interregional quantity model are presented together with the solution of the model as well as a comparison with the Miyazawa extended demographic model.

Finally, LINE, which is based upon the two-by-two-by-two principle, is used to examine regional impacts of export jobs for Danish municipalities. In the empirical analysis the direct export production and jobs by municipality is measured using SAM-K, which is a national account for Danish municipalities. On the basis of the direct export production and jobs the total effects of export, including both the indirect and the induced effects are analyzed using quantity model of LINE (Local Interregional Economic Model).

The analysis concludes that there are substantial differences in direct as well as total effects of export production and jobs:

Firstly, the higher the consumption rates (intermediate consumption, private consumption, governmental consumption) the higher the multiplier becomes. Also higher employment content and higher average income will other things being equal increase the multiplier.

Secondly, the smaller the leakages are the higher the local multiplier: Leakages can within the two-by-two-by-two framework of the local economy come from import via trade, out-commuting, outward shopping and tourism and will lead to lower the multiplier the higher leakages turns out to be.

## **Compilation of extended Supply and Use Tables in Denmark and possible applications in input-output analyses**

Topic: Management of Globalisation in the National Accounts and Implications for Input-Output Tables and Analyses

Author: Peter Roermose JENSEN

## **Modeling the Effect of Chinese Exports of Services Trade: A New Partially Endogenous Investments and Consumption Input-Output Model**

Topic: Structural change

Author: Maorong Jiang

Co-Authors: Min Wei

As an important method to describe national economy development, the input-output technique is a powerful tool for modeling analysis. And the input-output table which the input-output technique relies on is a significant extension of national accounting system, which could clearly record the input and output relations between sectors of national economy in detail. Based on the China Input-Output table 2012 and partially closed input-output model with endogenous consumption, this paper investigates the time lag of fixed capital investment and builds a new partially closed input-output model with endogenous investment, based on input-output technique and econometric theory. With the new model, we evaluate the short-term effects of the Chinese services trade exports. We find that, the growth brought by the unit exports of services is 119.80%, 123.52% and 83.22% respectively of that brought by the exports of good at the three aspects, including added value, employment and environment. The development of exports of services (especially producer service) has brought new growth momentum to the Chinese economy. Compared with the trade in goods, the cleaner and more efficient trade patterns of trade in services deserve to be promoted and developed.

## **Inter-country comparison of carbon footprint with purchasing price index adjustment**

Topic: Energy and emissions

Author: Eugénie Joltreau

Co-Authors: Norihiko YAMANO, Joaquim J.M. GUILHOTO

Measuring the impact of economic activities in units of carbon dioxide emissions (carbon footprint) is essential information to frame policies addressing the responsibility and behaviour of economic agents towards global warming. Recent analyses based on the OECD's Inter-Country Input-Output (ICIO) database have contributed to provide estimates of country and sector-specific CO<sub>2</sub> emissions embodied in domestic and foreign final demand for numerous economies. Such estimations have already improved our understanding on the distribution of CO<sub>2</sub> emissions along global value chains. However, these CO<sub>2</sub> analyses based on input-output tables in nominal monetary value are heavily biased due to considerable price differences across countries on the one hand, and differences in the electricity generation mix of countries on the other hand. In this paper, we compute CO<sub>2</sub> emissions intensity of the final demand adjusted by consumption price differences for the 35 OECD members and major non-OECD economies. Our results show that adjusting CO<sub>2</sub> intensity by purchasing price parity (PPP) substantially affects the countries'

ranking according to their demand-driven CO2 intensity. Taking a closer look at sectoral results, we observe a particularly high difference in the ranking for the construction, education and communication sectors. High differences between adjusted and non-adjusted final demand prices for the above-mentioned sectors may be attributable to labour-intensive production structures and low degree of market openness.

## **Economy wide impact of Regional Integration in South Asia - Options for Pakistan**

Topic: Power generation, extractive industries and regional integration

Author: Muhammad Aamir KHAN

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

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



## Financial Input-Output Table for Asia-Pacific Region

Topic: International Finance and Trade

Author: Jiyoung KIM

Co-Authors: Satoru HAGINO

Flow of Funds Accounts (FFA hereafter) refer to the statistics that describe how funds are transferred and where assets and liabilities exist in or outside a country from a bird's eye view. When it comes to global FFA, the bird raises the altitude to oversee the worlds as a whole so that cross-border transfer of funds and asset/liability relationship among countries. Although an original idea of global FFA had already been demonstrated by pioneers of FFA including Ishida (1993), recent currency and financial crises, in particular 2008 global financial crisis, has shed light on the usefulness of global FFA. Based on the that 2008 global financial crisis was caused by the inadequacy of statistical information on global financial economy, "The Financial Crisis and Information Gaps, IMF/FSB Report to the G-20" was published and it set the development of global FFA as a core in filling the gap between existing and necessary statistical information. The development of global FFA was push forward by the initiative of the International Monetary Fund (IMF hereafter), which monitors the global financial system. For example, Errico (2014) demonstrated the framework of global FFA using existing international statistics. The IMF has been working on the improvement of international statistics such as Coordinated Portfolio Investment Survey (CPIS hereafter) and Coordinated Direct Investment Survey (CDIS hereafter). Actual global FFA data, however, has not been produced yet mainly due to the absence of countries' Financial Input-Output (FIO hereafter) Tables or From-whom-to-whom FFAs, which are indispensable components of global FFA. It is expected that major countries will produce such tables in the near future to comply with IMF's Special Data Dissemination Standards plus. Under such circumstances, this paper tries to produce preliminary global FIO table focusing on Asia-Pacific region, which is a type of global FFA, and to identify its uses. The authors have exchanged the views with experts of the Bank of Japan, Bank of Korea, U.S. Federal Reserve Board and Statistics Canada, who are compilers of countries' FFA, as well as those of the IMF to discuss how to proceed. Based on such discussions, this paper discusses the method of converting countries' FFA into FIO and putting those FIOs, CPIS, CDIS and other international statistics into the framework of global FIO table. Then, it discusses the use of such table by applying the methods of input-output analysis.

## About Upper and Lower Bounds of Interregional Aggregation Effects.

Topic: Multiplier & Linkages Regional

Author: Dietrich W. Köppen

About Upper and Lower Bounds of Interregional Aggregation Effects.

Abstract

The upper and lower limits of interregional feedbacks in I-O models have played a role in theoretical and practical discussions of these multiplier effects. A parallel can be drawn to the analysis of biases which result if the aggregation level of interregional I-O systems is changed.

What can be said about the over or underestimation of intra and interregional trade multipliers,

comparing results of a given macro model  $M^*$  with those on a deeper level  $M$  with a more extended spatial differentiation. The question has a practical background if, for example, interregional I-O investigations have to work, typically because of empirical re-strictions, with spatial aggregates like the rest of the economy.

The paper presents an approach to determine the positive or negative direction of possible distortions but also verifies their upper and lower limits, thus giving hints on the reliability of the original results in case of unknown relations on a deeper level. The estimation procedure uses as less information as possible, serving eventually as a first step into further more cost intensive research.

The method is based on the comparison of input or output coefficients and final demand or primary input proportions using power series. All effects and limits can be observed for single industries or industry groups in each region, the partition of spatial aggregates into sub-regions is flexible. It can be shown under which conditions the aggregation effects reach a maximum or a minimum, if they matter or can be neglected and in which cases they disappear con-firming the original results.

From a methodological viewpoint, the concept makes clear in which way spatial but also sectoral aggregation effects depend on the distribution, especially the concentration of supplies and deliveries together with final demand relations within the aggregates. This extends the usual assumption that the biases are caused by the heterogeneity of units.

## **The sources of structural change in Brazil from 2003 to 2008**

Topic: Structural change

Author: Camila Unis Krepsky

Co-Authors: Esther Dweck

The years from 2003 to 2008 comprise a period of sustained growth after two decades of low dynamism in the Brazilian economy. This growth, however, did not take place in a homogeneous way among all industries being both cause and effect of changes in the productive structure of the country. This work seeks to investigate the sources of the structural change observed during the period by performing a structural decomposition analysis.

The structural decomposition performed in this work will be carried out in two stages: initially will be done a breakdown of the production growth of each industry into three components: (1) the change in the consumption pattern of the population (propensities to consume per product of workers in each industry), (2) change in the level and composition of the rest of total final demand, excluding final consumption and (3) change in the production technology, measured by the change in technical coefficients. In the next stage, to better understand the results obtained, the last two components will be further disaggregated, evidencing the effect of the change in the pattern of trade.

The novelty of this study is that the model used in the decomposition analysis considers the final consumption of households as an endogenous component, dependent on wages, and not exogenous, as in most models of decomposition in the literature.

The study will use the data of Brazilian Input-Output Matrices from 2003 to 2008 made available by WIOD (World Input-Output Database). It will also be used data related to the wages by

industry from the Brazilian National Accounts, made available by IBGE (Brazilian National Institute of Geography and Statistics).

## **An Extended Input-Output Table for Organic Farming**

Topic: Land-use change and agriculture

Author: Tobias Heinrich Kronenberg

The agricultural sector plays a key role in the context of Sustainable Development. On the one hand, it has a significant impact on the natural environment, for instance through greenhouse gas (GHG) emissions or the use of pesticides. On the other hand, agriculture will have to adapt to global warming, changes in precipitation and further challenges. Moreover, when consumers try to adopt more sustainable lifestyles, many of their decisions involve the use of agricultural products. They would like to know, for instance, the ecological footprint associated with a vegetarian or vegan diet, different types of farming (conventional or organic), and preferring regional products to imported products that may have travelled thousands of kilometers (“food miles”).

In principle, input-output analysis (IOA) can be a useful tool for studying the environmental impacts associated with food consumption and agricultural production. However, there are severe restrictions in terms of data availability. In the case of Germany, the official input-output tables represent agriculture in a rather crude form as only one industry (i.e. one column) and agricultural products are represented as one aggregated commodity (i.e. one row). The same is true for many other countries. These data limitations make it virtually impossible to distinguish between different types of food and different farming practices.

The goal of the present project is to explore how an extended input-output table could enhance our understanding of the links between nutritional choices, agricultural production, and the associated environmental impacts. We focus on the difference between organic farming on the one hand and conventional farming on the other hand. The project involves a literature survey, conceptual work on the input-output table, fieldwork in the form of interviews, and the construction of an extended model for the German economy with a disaggregated agricultural sector.

Previous research on different types of farming has identified significant differences between organic and conventional farming. One stream of literature focusses on the relative efficiency or profitability of the two different approaches (Breustedt et al., 2011, Brümmer, 2001, Brümmer et al., 2002, Kumbhakar et al., 2009, Oude Lansink et al., 2007, Tzouvelekas et al., 2001). Another stream is concerned with the environmental impacts resulting from food production and agriculture. These studies are often based on life-cycle assessment (LCA), focusing on individual products (Andersson et al., 1998, Berlin, 2002, Cederberg & Mattsson, 2000). Although LCA is conceptually similar to IOA; it has different advantages and disadvantages. Therefore, some authors have applied a combined IOA-LCA approach to the analysis of agriculture (Engström et al., 2007).

The present project contributes to the literature with a case study of German agriculture. Its goal is to develop an extended input-output table, where the agricultural sector from the official table is split into “organic farming” on the one hand and “conventional farming” on the other hand. We hope that the extended table will be useful for a variety of applications. For example, it can be used to study the difference between households consuming products of organic farming and products of conventional farming, including the environmental impact (e.g. greenhouse gas emissions) as well as the direct and indirect employment effects.

We have contacted a number of farmers who have agreed to participate in semi-structured interviews. Three interviews have already taken place, further interviews will be conducted in

February of 2018. Our goal is to have preliminary results by the end of February. Final results of the project will be presented at the international input-output conference in June.

## **Using machine learning to estimate energy and CO2 extension vectors for WIOD 2016 database**

Topic: Satellite accounts  
Author: Viktoras Kulionis

Significant attention has been devoted to the use of consumption-based accounting principle in the past few decades. Input-output analysis (IOA) has proved to be an ideal tool for this task. Nevertheless, the development of IO tables and in particular multi-regional input-output (MRIO) tables is a labor intensive and timely process. Many global input output databases (EORA, WIOD2013, EXIOBASE) come with the environmental extensions that permit analyses such as estimation of carbon and energy footprint. However, in some cases as for instance WIOD database released in 2016 does not contain such data.

The main aim of this study is to explore how machine learning techniques could be used to estimate energy and CO2 extensions vectors, that could later be used for the estimation of consumption and production based measures.

The data for this study comes from WIOD 2013 and from WIOD 2016 databases. WIOD2013 version is a system of MRIO tables, socioeconomic and environmental accounts. It covers 35 industries and 41 countries/regions, including 27 EU and 13 other major advanced and emerging economies, plus Rest of the World (ROW) region over the period 1995-2011 (environmental accounts only for 1995-2009). More recent WIOD2016 database provides data for 56 industries and 44 countries (28 EU, 15 other major countries and ROW region) for the period from 2000 to 2014. However, WIOD2016 only provides MRIO tables and socioeconomic accounts but does not provide environmental accounts.

This study uses WIOD 2013 data to train and test the model. Once the model is trained it is fitted with WIOD 2016 data in order to estimate energy and CO2 vectors.

## **Employment in green and conventional sectors in Zambia: an I-O analysis**

Topic: Development of Input-Output Benchmark Accounts  
Author: Massimiliano LA MARCA  
Co-Authors: Iljen DEDEGKAJEVA, XIAO JIANG, Marek Harsdorff

The paper describes the compilation process and structural characteristics of the most recent IOT for Zambia and explores the effects of sectoral policies on employment in conventional and environmental (green) sectors using IOT analysis.

ILO assisted the Zambian Central Statistical Office producing a Supply and Use table (SUT) and Input-Output Table (IOT) for the year 2010 following international statistical standards.

The 2010 SUT and IOT were published in October 2017 and provide the most recent and consistent data set for sectoral analysis for the Zambian economy. The SUT consists of 123 products and 24 industries identified following the Central Product Classification (CPC 2.1), International Standard Industrial Classification of All Economic Activities (ISIC), Rev. 4, and the on the recommendations of the 2008 System of National Accounts (UN, 2008 SNA) and the 2008 Eurostat Manual on Supply, Use and Input- Output Tables. The tables include environmental

sectors identified following the SEEA and EGSS guidelines. The selection of products and environmental sectors was based on availability of data and their importance to the economy.

The SUT was transformed into a product by product and industry by industry IOTs following a best practice compilation process: (i) the compilation of the supply table at basic prices, including a transformation into purchasers' prices, use table at purchasers' prices, and balancing of supply and use, (ii) the compilation of the use-side valuation tables in order to transform the product data into a homogeneous valuation at basic prices. The balanced SUTs at purchasers' prices are used as a starting point. The valuation tables consist of six types of matrices: trade and transport margin matrices, matrices on product taxes (non-deductible VAT, customs, and excise taxes) and subsidies, (iii) the estimation of the imports and domestic output use matrices, (iv) the transformation of the SUT at basic prices into a product by product IOT by using Almon procedure, (v) the transformation of the SUT at basic prices into an industry by industry IOT using the "fixed product sales structure" assumption.

The specific challenges, pros and cons of the two alternative transformations for the Zambian case are discussed.

The SUT and IOT tables are then paired with an estimation of labour employment by sector and occupation using the 2008 and 2012 labour force survey data.

The paper presents some scenario analysis based on policies drawn from the current Zambian National Development Plan (7NDP). The results for alternative policies, the effects on green sectors and their role on production and employment outcomes are discussed using the two alternative IOTs.

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## **A CGE model for the Spanish electricity sector: Testing some possible change scenarios**

Topic: CGE & energy-economy

Author: Raquel Langarita

Co-Authors: Rosa DUARTE, Geoffrey J.D. HEWINGS, Julio Sánchez Chóliz

While Spanish external energy dependence is high, in terms of electricity, Spain is not so dependent. However, given the importance of the electricity for the functioning of any economy as well as concerns about the energy dependence, in the Spanish electricity system there exist some critical issues, such as the low competition among the firms in this sector, the tariff deficit or several changes in the legal framework. In combination, analysts have shown that they have resulted in high prices of electricity, higher than the average of the European Union. In addition, another important characteristic of the electricity sector in Spain is that imports and exports are really low.

In this paper, we develop a static computable general equilibrium (CGE) model for Spain for 2013.

The model has 72 productive sectors, ten of which are energy sectors, three consumers and two productive factors, labor and capital. Using a nested production function that characterizes the current structure of the electricity sector in Spain, we also distinguish between electricity and non-electric energy. The electricity sector is divided into generation, transmission, distribution, commercialization and related activities, with the generation activity further disaggregated into wind, nuclear, conventional thermal, solar and other types and hydropower. The non-electric energy is also divided into gas and coke and petroleum. On the demand side, we also distinguish between energy and non-energy goods, as well as energy for households, for transport and electricity. The CGE model is calibrated on a previously developed social accounting matrix (SAM) with this detailed disaggregation for Spain for 2013.

Several scenarios are developed to explore some of the challenges: (1) increasing the integration with the European network to increase the competition among electricity utilities; (2) increasing of the use of renewable energy sources, while decreasing the use of brown energy sources; (3) increasing the competitiveness of the Spanish electricity sector. Preliminary results suggest that the electricity subsectors are heterogeneous because not all the sectors are affected in the same way nor in the same sense. Preliminary results also suggest that there exists a great interaction between imports and exports and total production; they three change in the same direction for almost all the cases. In the three scenarios planned, the welfare of the representative agent increases, which could be explained because, except for the electricity generation from nuclear, the price paid by the final consumer decreases.

## **Effects of Trade Policy on Technological Innovation in Agricultural Markets**

Topic: International Finance and Trade

Author: Lei LEI

The paper is motivated by a new EU regulation change. The new regulation has lowered the residue level of a chemical that is commonly used in apple production. To continue exporting apples to the EU market, technological innovation was developed in apple production in the United States. This paper adopts the Ex Ante approach to stimulate potential U.S. market reaction to both the trade policy change as well as the technological innovation. The model is carefully designed to consider 1) the output substitution between different varieties of apple and 2) the vertical linkage between the input and output markets. The paper finds that the policy induced

technological innovation (if effective) is beneficial, particularly to the product that is initially negatively affected by the policy change. It also has the potential to lead to product quality upgrade in the long run. The model and conclusion from this paper can be generally applied to other markets with highly differentiated products. IO data could be applied for more accurate parameter calculation in the future.

## **Multipliers and supermultipliers in a multisectoral framework: macroeconomic tools after all?**

Topic: Feedback Session 4b

Author: Fabrício Pitombo Leite

The paper aims to show that the common mistake of considering Keynesian income and/or employment multipliers as sector-specific, in a multisectoral framework, is taking its way back to economics. The phenomenon coincides with the recent debate about the macroeconomic Sraffian supermultiplier, as presented by Serrano (1995), and generates some new miscommunication by using similar terminology to sectoral multipliers. A revival of the tradition of the multiplier as a matrix (Goodwin, 1949) can be encountered in Mariolis (2017), which is largely based in Kurz (1985), despite the lack of references about the macroeconomic Sraffian supermultiplier. Estimates for that kind of static Sraffian multipliers for the Greek economy can be found also in Mariolis and Soklis (2018). On the other hand, Dejuán (2014) presents the macroeconomic Sraffian supermultiplier as a set of vertically hyper-integrated sectors (Pasinetti, 1988) without making a truly macroeconomic connection between sectoral multipliers and that ones for the economy as a whole. In order to throw some light on that debate, the present paper emphasizes the differences between the traditional input-output multipliers and its Keynesian counterparts, showing also the required adaptations for supermultiplier representations. Keynesian multipliers or Sraffian supermultipliers emerge as typical macroeconomic constructs, in spite of the fact that the knowledge on production structure and consumption (and investment) patterns is mandatory to capture them in a multisectoral framework. Some estimates for multipliers and supermultipliers are also presented using data from the World Input-Output Database (WIOD).

## **Exploring compiling methodolines of China's SUT Accounts**

Topic: SUT compilation: experiences from NSOs

Author: Huaju LI

Co-Authors: lihua dong

The Bureau of statistics of China [NBS] have conducted Input-Output survey and compiled I-O tables each 5 year since 1987. In order to improve the coherency and consistency of the National Accounts [to use supply and use tables as an accounting framework, NBS plan to compile SUTS in 2019. This paper consists of three sections. The first section gives a brief introduction of input-output accounts in China, the second section describes the supply-use framework. The third section discuss the data resources and methodology will be used to develop supply-use tables in China.

## **Constructing a China's Multi-Year Multi-Provincial Input-Output Table**

Topic: China's Interregional Input-Output Database: Construction and Applications

Author: Shantong LI

Co-Authors: Chen Pan, Jianwu HE

Unlike small-sized countries, China has a large territory and numerous provinces with different resource endowments, locational conditions, and development foundations. Therefore, when investigating China's issues, not only the nation-wide but also the regional analysis should be involved. As the nation-wide data have been well developed, the regional data are still fragmental. There is a lack of a consistent and complete regional database with a long time span, especially the data about the inter-provincial economic links. To fill this gap, we aim to construct a China's multi-year multi-provincial input-output table. We collect Chinese provincial IO tables for 1987, 1992, 1997, 2002, 2007, and 2012, and re-construct the data of international trade and domestic trade for each province in the provincial IO tables using the customs data. We then use the method of minimising cross entropy and gravity model to estimate interregional trade flows based on the railway transportation data. With all these information, we finally build a multi-year multi-provincial input-output database of mainland China covering 30 provinces (except for Tibet due to data limitation) and 33 sectors. We also apply this database to analyse the economic links between Chinese provinces and sectors throughout the historical years. This database could provide a foundation of regional data to those who focus on issues about China's economic development.

## **Unbalanced Productivity Progress and Urban-rural Dual Economy —Theory and Empirical Study based on China Historical Input-output Tables**

Topic: Regional & spatial

Author: Chen LIN

In order to analyze the urban-rural dual economy of China, this paper constructs a dual economy model under the framework of Sraffa-Leontief system. This paper argues that with migration barriers and price regulation, the unbalanced technology progress exacerbates the dual structure. To empirically prove the theoretical conclusion, this paper utilizes the newly compiled China historical input-output tables 1957-1973 (CHIOTs), which include 161 commodities and 17 sectors, to conduct a numerical analysis. The numerical analysis shows that in the past 60 years the actual price of agriculture product was lower than the theoretical price of the ideal unified economy. However, thanks to the relaxation of both migration barriers and price regulation, the gap is decreasing in the last 10 years.



## **Multisectoral Aggregate Supply- Aggregate Demand Analysis**

Topic: Multiplier & Linkages Investment

Author: Xinjian LIU

Co-Authors: Fengge Yan

Aggregate supply-aggregate demand (AS-AD) analysis is the coral model of theoretical analysis in modern macroeconomics. Traditional AS-AD analysis has two features, one is that its analytical indexes are aggregate, such as gross domestic product (GDP), aggregate consumption, total export and import, total price level, etc., and another is that intermediate demand is not considered. Compared with the traditional AS-AD analysis, the input-output analysis takes the structure of economic production and consumption sectors as its frame, and forms a multisectoral analytical system through the links of intersectoral demand relations. This paper sets up a model system of AS-AD analysis based on the input-output structure, and applied it to Chinese economy. The practice shows that the system is full of economic meanings.

## **Spatial Autocorrelation Analysis of Regional Direct Input Coefficients in China**

Topic: Micro data

Author: Xinteng Liu

Co-Authors: Xu Jian, Haoyang Zhao

Direct input coefficients are the core parameter of the input-output model, but few scholars use the method of spatial econometrics to study direct input coefficients. This paper introduces the theory and method of spatial autocorrelation into the input-output analysis innovatively, and study the spatial correlation of direct input coefficients of different sectors in various provincial administrative regions in China. We also attempt to analyze the spatial effects of direct input coefficients and changes of them in detail, and give economic explanations for spatial correlation. Based on the theory and method of spatial autocorrelation, this paper tests the spatial direct correlation carried out on 67 important direct input coefficients of input-output tables which are from 30 provincial administrative regions in China among 2002, 2007, 2012, and selects Moran's I to test the spatial correlation of direct input coefficients. This paper also makes a detailed analysis of manufacturing sectors characteristics and data characteristics for these direct input coefficients which present spatial autocorrelation feature. Moreover, this paper selects representative direct input coefficients of different spatial effects to analyze and summarize the feature of spatial correlation model. It is found that the relative geographical position is one of the influencing factors of direct input coefficients under the existing market environment and industrial structure in China. Further results show that the spatial correlation of the direct input coefficient is related to the manufacturing sector and the size of the coefficient itself.

Key words: Direct input coefficients; Spatial Correlation; Moran's I

## Indicators of Bilateral Trade Dependence in Global Production Networks

Topic: Feedback Session 3b

Author: Bart LOS

Co-Authors: Marcel Timmer

Recently, trade dependencies between countries have gained center stage in economic debates, as a consequence of political developments. In the present world, gross exports statistics are no longer a reliable guidance on assessing such dependencies: the export value contains a lot of value that has been added in more upstream production processes in other countries (see, e.g. Koopman et al., 2014). With the availability of global input-output tables like the World Input-Output Database (WIOD, Timmer et al., 2015) and the OECD Trade in Value Added database (OECD-TiVA) new measures have been proposed. They showed that early proxies to bilateral trade dependence which were based on single country input-output tables could be replaced by more accurate measures. A "dominant design" of these new set of measures has not emerged yet, as several different measures were proposed. While related, these alternatives have different and specific interpretations, which initially led to confusion, which is still lingering. This paper aims to provide a systematic discussion of the similarities and differences between three types of bilateral trade dependencies and proposes indicators for each of these.

The first type of bilateral dependence between countries A and B considered by us is the value added of A that is induced by B as the country where the consumption activities take place (B as the country-of-consumption), irrespective of the location of production activities that are more downstream than those executed by A and the country where the finalization takes place. Quantifications of this type of bilateral dependence can e.g. shed light on questions about the extent to which the GDP of a country is affected by increasing demand in emerging countries. The approach has been pioneered by Johnson and Noguera (2012).

The second type of bilateral dependence measures the value added of A that is induced by B as the country-of-finalization. Indicators like these would give insights into, for example, the consequences for Western European economies of the fact that China has managed to perform larger subsets of the activities in the GVCs for its final products within China itself (see Kee and Tang, 2016). The value of such a measure is not dependent on whether the final product is sold to B's consumers or exported. The first paper adopting this approach was Timmer et al. (2013).

The third type of measure looks at A's value added in its exports sold directly to B. This measure is not affected by what happens in more downstream stages than those performed by A. In this approach, B is considered to be the country-of-purchase. This approach (pioneered by Wang et al., 2013, Koopman et al., 2014, and refined by Los et al., 2016) is relevant for research questions related to the effects of barriers to trade. It could, for example, be used to get insights into the potential effects of the introduction of bilateral tariff barriers by the US on value added generation in Mexico.

In this paper, the concepts will be carefully introduced and their proper interpretation will be discussed. Furthermore, a common framework for computing indicators for the three types of bilateral trade dependence is presented. It is based on "hypothetical extraction", a popular technique in input-output analysis (see Miller and Blair, 2009). Finally, bilateral dependencies of the three types are quantified for a number of interesting pairs of (groups of) countries, using WIOD. We will also discuss and outline how newly developed data (such as extended supply-and use tables) will improve the accuracy of the indicators.

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## **A structural analysis of an input output bi-regional model of the Federal District of Mexico using hybrid methods to assess economic impacts, 2008-2013**

Topic: Subnational tables

Author: Esther Quiñones Luna

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The construction of input output matrices at the regional level using no-survey methods acquired great importance in Mexico, due to its capacity to measure the inter-sectoral relations of a region and the economic impact of some policy actions, mainly, the increase in investment in a specific sector, the rise in public spending, change of production or the household consumption in the cities.

The objective of this essay is to analyze the change in the productive structure of Federal District comparing the input output matrix of 2008 and 2013 in an economic recovery scenario; as well as measuring the economic impacts generated in the variables of final demand, the product structure, the generation of added value, imports and domestic demand in the Federal District and on the rest of the country. The main questions are: Which are the changes in the productive structure of Federal District? Which are the main changes in the components of the final demand, the productive structure measured by the productive linkages, the generation of added value and its composition, imports and domestic demand?

The novelty of this paper is the methodological proposal for the construction of a bi-regional input output model is that it is based on a hybrid method for the construction of supply and use table and use information as: State Gross Domestic Product, consumption of households, public institutions at the regional level and the economic censuses; and information at the national level. Subsequently, adjustment processes are implemented which allow accounting balances and a structural analysis to discriminate the economic impacts generated.

The analysis is organized in 4 sections: 1) The methodology for the construction of input output bi-regional model using hybrid methods; 2) An input output bi-regional model of the Federal District and the rest of the country; 3) A structural analysis of the input-output bi-regional model; 4) Conclusions

## **Regional Impacts of Climate Change on Health and Labor in Brazil**

Topic: CGE & energy-economy

Author: Aline Souza Magalhães

Co-Authors: Edson Paulo Domingues, DEBORA FREIRE, Gilvan Ramalho Guedes, Kenya Noronha

Global climate and environmental change have aggravated in the last decades (Nordell, 2007). Increased health stress is one of the most alarming consequences of these changes. The impacts of climate change on human health is complex, ranging from more direct consequences, such as increase in the prevalence of climate-sensitive diseases and in the demand for health care, to more indirect impacts, such as loss in labor supply (temporary through morbidity or permanent through deaths) and productivity (Pattanayak et al., 2009).

Although many studies have tried to estimate the direct and indirect consequences of a warmer and dryer environment for the economy, both at a global and local scale, a smaller number of studies have addressed the mid and long term health implications of these changes at a regional level. This study takes a multi-stage approach to estimate the climate-related consequences on cardiovascular/respiratory and infectious/vector-borne diseases, morbi/mortality, and labor supply in Brazil. Combining Spatial Bayes Smoothing, Spatial Econometrics, data on the Global Burden of Disease, and a Regional Computable General Equilibrium (CGE) model, this study estimates the future development of climate-sensitive health disorders, their implications for loss (gain) in morbidity and mortality, and the consequences for labor supply and productivity for the Brazilian states and regions from 2010 to 2040. As far as we know, this is the only study estimating the impact of climate change on health and economic development at the regional level.

To evaluate the impact of climate change on the Brazilian economy as a result of its impacts on the labor supply through health, we combine different sources of data and analytical strategies. Population health was proxied by two groups of variables: disease notifications (dengue, malaria, and leishmaniosis) and hospitalizations (circulatory, respiratory, and infectious diseases). These health indicators were derived from administrative health records by municipality. Climate parameters were proxied by precipitation (total amount of rain within one year and its standard deviation) and temperature (12-month average). The climate scenario used in this analysis was the Representative Concentration Pathways 8.5. The effect of climate change on the labor supply was obtained by a two-step strategy. The first step estimates the relationship between climate change and health. Building on Bosello et al. (2006) and Pattanayak et al. (2009), the second step analyses to what extent health losses due to climate change affects the labor supply based on the Global Burden of Disease parameters (WHO, 2016). The change in the number of cases estimated for the working age population (labor supply) was used in a computable general equilibrium model to verify the effect of climate change on the Brazilian economy by 2040.

Our IMAGEM-B (Integrated Multiregional Applied General Equilibrium Model - Brazil) incorporates detailed data for the Brazilian economy, yielding the climate impact on the main macroeconomic variables, such as Gross Domestic Product (GDP), employment, and family consumption. These impacts are reported at both national and state levels and are evaluated as the percentage cumulative deviation from a base scenario without considering the change in the climate parameters (business-as-usual).

We found a link between climate change and health, although this relation varies by disease and

by region. The prevalence of circulatory diseases is expected to decline from 2005 to 2040 due to the projected increase in average temperature across most municipalities in Brazil. Consequently, the morbi-mortality rate from circulatory disease is expected to decline, yielding an increase in the labor supply by 2040. This effect is more pronounced in the South. The impact of future climate change on vector borne and infectious diseases is higher in magnitude when compared to the chronic conditions. Overall, prevalence of infectious diseases, with large, and dengue more specifically, is expected to increase across all regions, resulting in higher morbimortality rates and significant loss in the labor force by 2040. Change in the prevalence of all three diseases will be higher in the North and in the Center West. Despite the increase in the prevalence, rates themselves are low in magnitude (but high if compared to other countries). Therefore, additional morbi-mortality and loss in the labor force due to climate change would increase only marginally. The impact of the projected climate change on labor (from the demographic model) is higher than its computed effect in the economy (from the computable regional general equilibrium model). The CGE result shows that increased morbi-mortality and labor loss would be higher for vector-borne and infectious than for non-communicable diseases, and mostly concentrated in less developed regions of the country.

## **European NUTS 2 regions: consistent Inter-regional Trade and Transport flows estimation**

Topic: Regional trade

Author: Giovanni MANDRAS

Co-Authors: Mark Thissen

Economic development is inter-regional in nature, where physical and technological proximity determined by inter-regional and national cross-border interactions in trade, investments and knowledge are important determinants of economic growth. However, quantitative policy research analysing regional development in Europe such as proposed in the regional smart specialisation strategy (McCann and Ortega-Argilés, 2011) has been hampered by data deficiencies. This is particularly the case for the data and the empirical evidence on inter-regional trade relations. The existing data on inter-regional trade are incomplete and based on data points which are far in the past.

This study focuses on the estimation of inter-regional trade in goods and services of the regions, within the same country as well as with regions in other Member States. The estimation is based on a rationalisation of Supply and Use Tables. The production and consumption of goods and services in the European NUTS 2 regions were subsequently interlinked using data on both freight transport (5 modes) for goods and business travel (3 modes) for services. The estimated transshipment locations and the number of transshipment are specific for every good on every trade link.

Regional supply and use tables (SUTs) are the basis for the estimation of the inter-regional trade flows. We use supply and use tables rather than Input-Output tables, because the focus is on the regionalization of both trade and regional technological coefficients (the use and supply of products by different economic actors). An input-output table is built around the assumption that every sector produces only one good. Therefore, depending on the type of IO table, either the sectors are not comparable over the nations and not comparable with regional sector statistics, or products are not comparable over nations and not comparable with trade statistics. Hence, a regionalization of IO tables cannot make use of both regional sector statistics and regional trade statistics.

The central principle in our methodology inferring European regional trade flows from different sources of information is increasing data reliability by imposing consistency with available

statistics. Regional trade flows need to be consistent with statistics on production and consumption per region, which, in turn, must be in line with national data on production and consumption. These regional flows must also be consistent with international trade statistics, on a national level. Trade statistics should be mutually consistent. That is, exports from a region or country A to a region or country B should equal the opposite flow of imports received by region or country B. All these consistency checks provide additional information and therefore add to the quality of the estimated trade flows.

The methodology extends the approach proposed in Thissen et al. (2013) (in line with 'parameter-free' universal methodologies as proposed by Simini et al. (2012)), to improve upon the validity and the quality of the estimate by incorporating the estimation of transport flows into the trade flows estimation. The methodology is based on the distribution of probabilities of transport flows between regions used to estimate transshipment locations, specific number of transshipment per good and the amount of goods and services traded between regions.

Finally, in this study we determined the trade between NUTS 2 regions given the data on freight transport and regionalized SUTs for the EU28 regions.

## **The Business Accounting Matrix: a proposal with an application.**

Topic: Feedback Session 5a

Author: Casiano A. Manrique\_de\_Lara\_Peñate

Co-Authors: Jose Juan Deniz Mayor

Enterprise input-output has been the subject of IO research for many years now. Being based on input-output tables and models these efforts has obviously been concentrated in models combining activities in a firm and goods and services required or produced (demand and price models). In the same way as a National Accounting Matrix (NAM) extends the information given by an IOT covering all flows related to the generation, distribution and use of income, we propose to construct a similar framework at the firm level. As far as we know, this effort has not been previously undertaken.

In this contribution a framework to develop business accounting matrices (BAM) based on the methodology of preparation of NAMs is presented. A BAM provides a link between the richness of information generated by financial accounting and the analytical capacities of economic accounting. The BAM offers a panoramic and structured view of all significant economic flows and the relationships between the different agents related to the firm's economic activity. We hope our proposal could help to establish some standards in the preparation of a BAM.

The BAM highlights the main aggregates of the economic and financial activity of the firm. It first shows the Value Added generated by the main operating activity of the company. Adding other sources of income and the result of the redistribution instruments of the public sector, aggregates related to the generated income can be defined. Incorporating financial and investment flows helps establishing the net financial needs of the firm. We have prepared the BAM of a concrete firm (Hotel business in Spain) to show a concrete application. We believe the availability of a BAM would enhance the economic modelling possibilities at the business level.

## **Upstreamness, exports and international competitiveness: lessons from the case of China**

Topic: GVC upgrading

Author: Marilia Bassetti Marcato

The last decades have witnessed significant changes on how the world production and international trade are organized, with countries becoming specialized in specific parts and tasks within global value chains (GVC). With that backdrop, this paper investigates the Chinese specialization pattern in vertically integrated production networks connected by international trade. Particularly, we aim at integrating the most widely accepted metrics based on the concept of trade in value added, that is, country's GVC participation, the relative GVC position, as well as an analysis of the different components within the total foreign content, the Revealed Comparative Advantage index in value-added terms and the Economic Complexity index. In so doing, the empirical exercise that follows is based on OECD-WTO Trade in Value-Added (TiVA), the World Input-Output Database (WIOD), and Simoes and Hidalgo (2011) from 1995-2011. The results in this paper suggest that China's production has advanced to other stages located more at the beginning of the GVCs, while it has deepening its importance on the cross-country production sharing and becoming less dependent of intermediate imports embodied in its exports. However, the decline in re-exported intermediate imports in China was not translated into lesser diversification of its exports. On the contrary, China has climbed the ladder of production complexity, while becoming more integrated into world trade and relying less and less on imported inputs, as well as becoming more competitive in the production of components.

## **Rethinking total factor productivity and economic growth from Input - Output Model**

Topic: Growth Accounting

Author: Marco Antonio Marquez

The input-output model has used the contributions of the neoclassical school to study total factor productivity. However, these contributions have overlooked the nature of Leontief's model. In this paper, neoclassical postulates without strict convexity are used to argue that total factor productivity is composed of two types of effects, the substitution and the price-cost effect. Based on this proposal, I identify two types of growth paths in the economy and demonstrate that the proportional contributions between supply and demand are the most favorable for development. Thus, if a complex productive structure means developed economy, I would add that the latter fulfills the conditions of equilibrium between the contributions to growth of savings and investment. This paper tests this against the OECD database for six developed economies.

## **Input-Output Approach as an Instrument for Estimation the Impact of the Extractive Industry Sector on the Economy of Tajikistan**

Topic: Power generation, extractive industries and regional integration

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## Input-Output Approach as an Instrument for Estimation the Impact of the Extractive Industry Sector on the Economy of Tajikistan

The Republic of Tajikistan, a part of the former Soviet Union, is a mountainous landlocked country in Central Asia. Economic advantages of Tajikistan include, among others, abundant water resources, favorable climate conditions and cheap labor. Cotton growing, viticulture, horticulture and aromatic plants growing are the major sources of livelihood. Industrial products in the Republic of Tajikistan include metallurgy, mechanical engineering, and production of durable consumer goods, light industry, and food industry.

Tajikistan is extremely rich in natural resources but there are major of challenges in converting these resources into wealth. Natural resources of Tajikistan have been explored and partially excavated for industrial purposes. It is estimated that more than 600 deposits and 800 potential sites for excavation are found in Tajikistan. These minerals are iron, zinc, antimony, uranium, coal, oil, natural gas, mercury, gold, silver, precious/semiprecious stones, building materials, hydropower potential etc.; Although mining sector has enormous potential for Tajikistan, its impact is still limited. It represents only 3.07% of gross domestic product (GDP), 4.2% of national budget, 5.18% of employments and 23.25% of exports (EITI-Tajikistan, 2015).

Tajikistan economy is still in a transitional stage. Government is struggling with various challenges that have occurred after the independence but is not yet ready to deal with current global challenges. The government has failed in converting the country's potential into real national wealth.

The main challenge facing Tajikistan is to find new sources of revenue for national budget from which government will be able to tap additional tax revenue. The extractive industry may provide a good opportunity for this new source of revenue.

If Tajikistan wishes to use extractive industry as a main source of revenue, it is necessary to establish strong governance underpinned by a transparent and accountable management system of natural resources. Lack of good governance in the extractive industry may lead to corruption with negative impact on the economy. If Tajikistan would be able to establish good governance, it would help the economy to grow in a more sustainable manner.

At the present time Tajikistan does not have Input-Output Tables which is one of the most important macroeconomic policy tool. This research is going to develop Input-Output Tables which would be applied to macro-economic analysis of Tajikistan with a significantly contribution to the national economy. Therefore, the overall objective of the research is to ensure extractive industry to be developed and managed in a transparent and accountable manner so that all segments of the society can benefit from prospective expansion of the extractive industry. This would require: (1) grasping the potential magnitude of the impact that the extractive industry of Tajikistan can bring (through Input-Output Analysis) and also (2) instituting stronger governance for the extractive industry sector.

In order to achieve the above objective, the following research questions have been developed to guide the entire process of the research:

- (1) What impact will the growth of the extractive industry bring to the economy of Tajikistan?
- (2) What government policies should be adopted in order to ensure the extractive industry sector to be managed in a transparent and accountable manner so that extractive industry can contribute to the sustainable development of the Tajikistan's economy?

This research would be primarily carried out with use of quantitative analysis, which would be



supplemented later by the qualitative analysis. Quantitative analysis is primarily designed for assessing the impact of extractive industry on the economic growth with use of an Input-Output table model. The quantitative method would be supplemented by the qualitative analysis, which would gather expert's views on the effective ways of managing the extractive industry.

Keywords: Tajikistan, extractive industry, economic growth, impact on economy, Input-Output Tables.

## **An Input-Output Analysis: What Would a Low-Carbon Economy for Brazil Mean?**

Topic: Drivers of energy consumption

Author: Florent John Mc Isaac

Mixing economic growth with low-carbon objectives entails multidimensional challenges among which a shift in employment and a rapid transformation of infrastructure are involved. The aim of this paper is to provide a data-driven analysis to strengthen our understanding of what a low-carbon economy for Brazil would mean. Ultimately, our aim is to narrow the policy makers' spectrum of analysis when facing low-carbon economy objectives by using much information from the IOT in three ways: (i) identifying the current economic landscape; (ii) determining the potential transmission channels of assets that are written off balance sheets when capital becomes stranded; and (iii) understanding the sectoral implications of a low-carbon economy in the labor market. For planning low-carbon trajectories in Brazil, we find that: first, the economic landscape exhibits a significant drift towards oil-related industries--especially the chemicals sector--that may generate frictions in designing tomorrow's low-carbon economy; second, the financial and the oil sectors are highly interconnected and should be dealt with together; third, the wholesale sector appears to be basic and systemic, therefore economic policy should pay particular attention to this sector; and fourth, when assessing NDC impacts on the labor market we find that shifting activities from oil derivatives to biofuels is likely to create jobs while moving away from the extractive sector may increase unemployment.

## **Health Care and the US Economy in the 21st Century**

Topic: Policy Analysis with Interindustry Models

Author: Douglas S. MEADE

Abstract

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Title: Health Care and the US Economy in the 21st Century

Author: Douglas S. Meade, INFORUM

Long-term projections of the U.S. economy and the scope of health care in the economy to 2091 are useful for long-term budgeting of the Medicare and Social Security Trust Funds, as well as for health care policy analysis. In this paper we describe the use of the Inforum LIFT long-term industry macro model to portray a consistent base case projection of health care and the economy to 2091, and then sketch out the use of alternative scenarios that serve both to bracket and better understand the assumptions underlying those scenarios and their implications.

In this paper we describe the development of a baseline for the U.S. economy and health care spending to 2091. We delve into some of the special considerations involved in making a scenario for a period of this length, especially the contributions of demographic changes, labor

force and productivity.

In addition to this scenario, we develop 4 alternative scenarios to explore. The 5 scenarios are:

1. Long-Term Baseline. The baselines are congruent with the Trustees projection of economic growth, population and demographic composition, productivity growth, and national health expenditures, under a “base” case and an “illustrative alternative” that assumes more rapid growth in Medicare prices paid to healthcare providers and faster growth in health spending overall.
2. Higher Health Spending. This scenario is similar to the Baseline, except that it follows the higher-growth spending pattern for Medicare and NHE from the “Illustrative Alternative” from the Medicare Trustees.
3. New Normal. Continued Slow Growth, Low Inflation, Slow Productivity Growth
4. Higher Healthcare Productivity. Health care productivity growth rises to match that of the overall economy.
5. Insufficient Federal Revenues. Federal tax rates do not rise to match the growth of health program spending shown in the Baseline.

The first section of this paper reviews some key facts about the recent U.S. economic history and the behavior of health care spending. Section 2 delves into the logic and rationale of the 75 year projections, and the related long-term projections made in the Trust fund reports and by CBO. Section 3 provides a brief description of the LIFT model. Section 4 describes the development of the Baseline, including a section on the steps involved and the assumptions and considerations that need to be made. Summary and highlights of the baseline are also in this section. Section 5 describes alternative scenarios that shed light on changing several important assumptions in the baseline. Section 6 concludes, and projects some avenues for further development of this analysis.

## **How immigration can raise wages -A case study of Pakistan**

Topic: CGE & energy-economy

Author: Ayesha Mehtab

Immigration may bring considerable benefits but it is not necessary that it always represent significant results. This may have an unfavourable effects on the host country. However as in the case of afghan immigrants who started to move in Pakistan in late 1970s during soviet war in Afghanistan. According to UNHCR (2017), still there are about 1.3 million registered afghan citizens in Pakistan. The purpose of this study is to examine that how an immigration in Pakistan can raise wages. The outcome of Afghan immigration shows that wages in Pakistan fell because employers can easily have found substitute among workers of same skill. Although an immigration of unskilled labour build up the demand of native workers with complementary skills. But this cross-price wage benefit found out to be very small. With this backdrop, we used a global Computable general equilibrium model calibrated with latest Social Accounting Matrix (SAM) of Pakistan to study how immigration impact real wages. The results show that if producers in Pakistan will hire more skilled labour and capital to make the best use of unskilled afghan immigrants. This will boost up the demand and prices of skilled labour and capital as well. An increase in capital stock not only escalates the demand of both workers (skilled and unskilled) but also increase their wages.

## **Employment and foreign trade in Mexico 1980-2012. An Input-Output Analysis**

Topic: GVC Trade

Author: ABRAHAM ISRAEL MENDEZ

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Employment and foreign trade in Mexico 1980-2012. An Input-Output Analysis

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**Abstract:** This paper analyses the capacity of the economy to generate employment in 1980 and 2013, two far apart years useful to exemplify the structural evolution of the economy, under different growth strategies, one based on imports substitution and another promoting exports, although some authors characterize it as highly dependent on imports. The generation of employment can also be related to different components of final demand, e.g. exports, consumption, investment, etc. which is helpful to characterize the development pattern of the economy, besides the technical component related to the inputs coefficients. The official Input-Output tables for both periods have been elaborated with different criteria; in order to make them comparable, we have added reclassified the 814 products table for 2013 into 72 branches. The economy does not appear to have increased its capacity to generate employment, not least because of the increased dependence on imports.

## **Economic costs estimation of natural disasters in Mexico. Impact of Hurricane Alex in Nuevo León, 2010**

Topic: Disaster Analysis

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Mexico is a country highly affected by floods, due to climatological, geographic and demographic factors. It is estimated that the frequency and intensity of these phenomena will intensify in the coming decades, derived from climate change. The high costs associated to flooding events would represent an obstacle to economic development.

Adaptation and risk management measures are largely based on costs damage evaluation, so it must be comprehensive. This paper estimates the costs caused by Hurricane Alex in Nuevo Leon, Mexico, in 2010, the most devastating in the last 50 years. A methodology that considers indirect costs in all economic sectors of the affected region was applied by the first time in a Mexican case. Indirect costs are defined as the impact on production due to material damage. The methodology incorporates the fundamentals of Input Product modelling, allowing for sectoral and regional analysis.

The results show that each monetary unit of material damages caused additional 0.30 monetary units of damages to production in the rest of the regional economy. This type of analysis provides information that allows the evaluation of risks and damages caused by flooding events and other hydrometeorological disasters, and the dynamics of costs distribution along the industrial sectors.

## **The role of intermediate trade in the change of carbon flows in China**

Topic: Feedback Session 1b

Author: Jing MENG

In recent years, evaluating the emissions embodied in trade (EET) has become a hot issue in policy and research. Multiregional input-output analysis, which links producers and final consumers, is a favoured method for quantifying the EET. However, the role of intermediate trade in driving changes in the EET is still not fully understood. Here, we present a framework that separately identifies the drivers of the emissions embodied in trade of final and intermediate products. In a case study, we analyse the changes in CO<sub>2</sub> emissions embodied in interprovincial trade in China from 2007 to 2012, which is driven by rising final demand and offset by decreasing emission intensity and changing interregional dependency. Regionally, the rising imports and final demand in less developed regions (e.g., Hebei and Henan) reduced the emissions outsourced by central coastal regions and drove the flows between central and western regions. The framework can enrich our understanding of the role played by intermediate trade in the relocation of emissions.

## **The role of exporters and domestic producers in GVCs: Evidence for Belgium based on heterogeneous national supply-and-use tables integrated into a global multiregional input-output table**

Topic: National data in Global IOTs

Author: Bernhard MICHEL

Co-Authors: Caroline Hambÿe, Bart HERTVELDT

Even in times of a slowdown in the pace of global trade growth, participation and optimal positioning in global value chains (GVCs) may yield substantial benefits for countries in terms of welfare gains and job creation. This holds true in particular for small open economies like Belgium. Therefore, in order to make informed economic policy choices, it is crucial to get a clear picture on how a country's firms participate and are positioned in GVCs. The aim of this paper is to refine this picture for Belgium by producing data on GVC participation and trade in value-added separately for two groups of manufacturing firms: those that are export-oriented and those that mainly serve the domestic market.

Traditionally, Belgium is highly integrated into GVCs: a large share of the country's value-added is driven by foreign consumers (De Backer and Miroudot, 2014) and Belgian service industries tend to be well integrated into GVCs indirectly, i.e. through intermediate input deliveries to exporting manufacturing industries (OECD, 2015a). As suggested in OECD (2015b), the analysis of the country's integration into GVCs could be further refined with IO tables that distinguish between firms according to their exporter status. Indeed, technology is likely to be better reflected by separating export-oriented firms and producers that mainly serve the domestic market at the industry-level. This would then allow to better map domestic value chains and measure the indirect contribution of non-exporters to exports through intermediate deliveries. However, observations on GVC integration are based on evidence derived from global multiregional input-output tables (GMRIOs). Therefore, to enhance the value of the analysis, it would be useful to integrate national tables into GMRIOs. In turn, this raises the issue of consistency with national data because, due to global balancing, country data in these tables is not necessarily entirely consistent with national data, i.e. national supply-and-use tables (SUT) and input-output tables (IOT), in particular regarding foreign trade. This is a drawback, especially for small open

economies like Belgium and it may alter analytical results (see the carbon footprint calculations in Hambÿe et al., 2017).

To address these issues, we have produced a national IOT with a split of manufacturing industries into export-oriented firms (exporters) and firms that mainly serve the domestic market (non-exporters) for the year 2010 and integrated it into the global multi-regional IOT of the WIOD project for that year. For the construction of the national IOT with the exporter split, we have used the full individual firm-level data resources that serve for the construction of Belgium's official tables (annual accounts, structural business statistics and extensions, survey on industrial production, VAT transaction data, exports and imports). The novelty of the approach is twofold: the disaggregation of the industry-level output, input and import structures in the SUT and IOT are data-based rather than just proportional, and the integration of the Belgian tables into the GMRIO table is such that these Belgian data are not modified. As a first step, we have identified exporters in manufacturing industries as firms that export more than 25% of their output. This yields a sample split into exporters and non-exporters. Based on this, we have split the national accounts aggregates for manufacturing industries according to these two categories of firms. In a second step, we have relied on the more restrictive sample of firms that declare output and intermediate input purchases by product (in an extension of structural business statistics) to disaggregate the columns in the supply table and in the use table. Moreover, firm-level import data has allowed us to disaggregate the columns of the import use table. The next step then consisted in deriving a heterogeneous national industry-by-industry IOT. Finally, as a last step we have integrated this heterogeneous Belgian IOT into the global multi-regional IOT from WIOD for 2010.

Based on these tables, we will compare the two categories of firms (exporters and non-exporters) in terms of the value-added intensity of their output and their use of imported intermediates. We will also evaluate the similarity of the input structure of exporters and non-exporters. Moreover, we will use the national heterogeneous industry-by-industry IOT to look at differences in multipliers between the two types of firms for the same industry, and we will determine to what extent non-exporters generate value added through the delivery of intermediates to exporters. Finally, based on the global multi-regional IOT from WIOD into which we have introduced industry heterogeneity for Belgium, we will look at the participation and position of Belgian exporters and non-exporters in GVCs.

## **Decomposition of Value-Added in Gross Exports: Unresolved Issues and Possible Solutions**

Topic: Value Added in Trade and the OECD ICIO

Author: Sebastien MIROUDOT

Co-Authors: Ming Ye

The rise of global value chains (GVCs) has significantly transformed the structure of international trade, with implications for the generation of income across countries. To better understand trade in the context of GVCs, it is important to have a full and explicit decomposition of value-added in exports. While the decomposition proposed by Koopman, Wang and Wei (KWW, 2014) is a first step in this direction, there are still three outstanding issues that need to be further addressed: (1) the nature of double counting in gross exports and the meaning of the "pure double counting terms" identified by KWW; (2) the calculation of the foreign value-added in gross exports consistent with GDP and net of any double counting; and (3) the decomposition of gross exports at the industry level (the industry where exports take place).

In this paper, we propose a new accounting framework that addresses these different issues and

clarifies the definition of exports in inter-country input-output (ICIO) tables. This mathematical framework allows the decomposition of gross exports into domestic value-added, foreign value-added and double-counted value-added (which can be domestic or foreign). It contributes to the literature: (i) by refining the definition of double-counted value-added in gross exports; (ii) by providing new expressions for the foreign value-added and double-counted terms; and (iii) by indicating how the new framework can be used to decompose exports at the industry level.

The novelty of our approach is that we decompose gross exports in a consistent input-output framework starting from world GDP and analysing exports from the point of view of the destination country (where final consumption takes place). We show that our results can be obtained both through the Leontief model and the Ghosh approach. We rely on the Ghosh approach to provide a consistent definition of double-counting and how value-added in exports is generated through an initial round (corresponding to domestic value-added), a first round (where foreign value-added can be identified) and later rounds that only include value-added already measured in the initial and first rounds (and thus corresponding to double counting).

Our new approach confirms the results of KWW on the domestic value-added side (domestic value-added and domestic double counting) but provides different results for the foreign value-added and foreign double counting. Our results for the domestic value-added in exports are also fully consistent with the hypothetical extraction method from Los, Timmer and de Vries (2016). We illustrate this with the decomposition of gross exports in selected countries using the WIOD dataset. Moreover, we provide a 10-term decomposition of gross exports (that can also be done at the industry level) with terms similar to the 9 terms described in KWW, but with a full symmetry between the domestic and foreign value-added terms. We explain how our approach leads to different results.

## **Copper forecasting Chile (COFORCE) - methodology and design of a macro-econometric input-output model for the Chilean Economy**

Topic: Modeling the Chilean Economy to Analyze the Future of its Mining Sector

Author: Anke M. MOENNIG

Co-Authors: Loreto Bieritz, Anett GROSSMANN, Frank Hohmann, Marc Ingo Wolter

The research project "Development of sustainable strategies in the Chilean mining sector through a regionalized national model" will analyze the socio-economic impacts of copper on the Chilean economy. For this a regionalized national model will be developed from scratch. It is based on the modeling philosophy of the INFORUM group and characterized as a macro-econometric input-output-model.

The analysis of copper and mining sectors are a major issue in Chile. Many studies have focused on this research area, but mainly do ex-post analysis and use General Equilibrium Models. Different to these approaches, we built a dynamic input-output model for the Chilean economy where parameters are estimated and the model equations are solved iteratively over time and no equilibrium condition are met. That means for instance, that the labor market does not necessarily balance also in the long run. The main features of the model are bottom-up modeling on 73 industry levels, total integration of input-output tables and national accounts that considers not only inter-industry relations but also income distribution and use. Further characteristics are bounded rationality of economic actors, imperfect markets as well as price rigidities. Demand and supply are both treated equally. The projection horizon of the model is 2035. The data used are official datasets compiled and provided by the Chilean project partners.

This paper is a methodology report on the construction of the model. It introduces the general

modeling concept, shows some of its regression functions and the estimated parameters and illustrates the results of the baseline scenario of major indicators of the total economy and its sectors.

## **How wage sensitive is the German labour market? A sensitivity analysis using the German input-output model INFORGE**

Topic: Policy Analysis with Interindustry Models

Author: Anke M. MOENNIG

Co-Authors: Marc Ingo Wolter

This paper analysis the wage mechanism and its impact on employment. Basically, two forces can be observed: the cost effect and the income effect. Both effects coincide and may weaken or inforce the primary impact which depends mostly on the strength of price elasticity on the cost and on the demand side. A sector specific analysis is vital as price elasticities vary across different branches. This complexity of interaction is hardly to be solved by qualitative analysis but requires a quantitative and sector specific approach.

This paper examines sector specific wage reactivity by occupations by applying a macroeconometric input-output model. The applied model is an INFORUM-type of model with features such as bottom-up and total integration. As used herein, INFORGE is a national model only and is not linked to other models of the INFORUM family. INFORGE solves simultaneously and is dynamic over time. Parameters and their elasticity values are estimated econometrically. Input-output tables and national accounts are the two main datasets and allow to capture direct, indirect and induced transmission mechanisms. The labour market in this version of INFORGE has been extended with detailed data on employment and wages by sectors and occupations. Labour demand and supply are linked on occupational level. Wages are estimated on occupational level determined not only by sector specific productivity changes but also by occupation specific labour scarcity.

The sensitivity analysis assumes a 1% additional wage impact on sector specific wages by occupation. Separately and consecutively, the 1% impact is added on 116 sector specific wages by occupation. By using four different indicators (radius of impact on macro level, Hoover-distribution on occupational level, Herfindahl concentration on sectoral level, Low-qualification-quotient), the impact on employment are evaluated.

The results confirm basically the dominance of the negative impact on employment of wage increases in all occupations. However, the decrease is in all cases are lower than the primary impact suggest. However, the direct negative impact are overcompensated in some occupations with a large number of employees due to the raise in income: employment increase can be observed in other sectors.

## **Research and development and productive structure: assessing the economic effects of the public financing on Brazilian economy**

Topic: Investment and capital formation

Author: Rosa Livia Gonçalves Montenegro

Co-Authors: Admir Antonio Betarelli Junior, Eduardo Gonçalves

Research and development (R&D) become an essential requirement for economic sectors to innovate and in adapting to changes in the competitive environment of the domestic and external market. The sector expenditures are classified between internal activities and external

acquisitions in R&D, whose amounts can be financed by own, third parties and public capital. Especially public capital represents the second largest R&D funding source in Brazil, but its allocation differs by sector. An issue in debates about public R&D funding is to understand their role in the economic effects projected on the Brazilian economy. The main aim of this paper is to analyze the in time path of deviations of the macroeconomic and sectorial variables indicators without public capital R&D until 2020. We use a dynamic general equilibrium model so that its core database is based on the 2010 Brazilian Input-Output table with explicit R&D expenditures. The main findings of this paper indicated that lack of capital public R&D promote negative effects on GDP growth, exports, and investments in Brazilian economy until 2020. Besides, the sectorial projections suggest negative effects on vehicles and equipment for transport, communication and information technology, as well as chemical products, which are most intensive in public capital R&D.

## **Labor values and prices of production: a new theoretical and empirical approach on the transformation problem**

Topic: Sraffa and Ghosh

Author: Mario Salomón Montesino Castro

Co-Authors: Armando Andrés Álvarez, Juan José López, Meraris Carolina López

This article inquires the relationship between the market prices and the analytical prices of the labor theory of value in El Salvador's economy between 1990 and 2006. A new methodological perspective is proposed for the labor value and the production's prices, measured with an emphasis on the distinction of the labor's complexity of Marx and the importance of the full payment of the value of labor power. The data utilized for these estimations comes from El Salvador's input-output tables from 1990 to 2006, obtained through the transformation of the supply and use tables with the model B of Eurostat. The article's novelty is the theoretical approach for the values and production's prices measuring; moreover, is one of the first research on this topic in a Central American country. The fundamental Marxian's variables obtained are compared with the approach used by Shaikh (1984, 2016); Ochoa (1984, 1989); Sánchez and Nieto (2010). Furthermore, the correlation coefficient between the market prices and the values is calculated.

## **THE IMPACT OF MORTALITY AND MORBIDITY ON THE BRAZILIAN ECONOMY: INPUT-OUTPUT ANALYSE**

Topic: Welfare programs

Author: Everlam E. MONTIBELER

Co-Authors: Magda Da Silva Pandini

The scarcity and inefficiency of health resources has been a major problem faced by most countries. However, a first step toward the solution of this problem hasn't been addressed: the measurement of the economic impact of morbidities and mortalities. This paper proposes to rank the per capita cost of each disease, the impact on GDP, consumption and employment for the Brazilian society. To measure the losses in terms of lost days worked, the methodology developed by Murray and Lopez (1996) used for the estimation of impact of disease-related mortality and morbidity. As consequence of this effort, we have the DALY (Disability-Adjusted Life Years) database provided by WHO (World Health Organization). The input-output method made it possible to calculate the direct and indirect impacts of the main diseases on GDP for the last



years, as well as to see their evolution.

## **The emergent properties of the determinant of the Input- Output matrices: the case of the relationship among functional income distribution, labor productivity and the index of circularity**

Topic: Mathematical analysis of input-output data

Author: Eduardo MORENO REYES

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

This paper have two mains motivations; first, to expose the possibility of interpreting the determinant of input-output table as an indicator that captures the complexity and technological change of an inter-industry system, through the circularity index; second, to answer the question: "Is the complexity and cost of new technologies and their impact which changes the structure of income and labor-saving and modify the production function towards more capital intensive methods? ".

The sectoral circularity indexes (Latner 1972, Gazon 1976) are indicators that allow to measure the technological change and the complexity of the network associated with an input-output table. Therefore, when this indicator is related to labor productivity and the functional distribution of income (measure as the share of wages in the value added) through Granger & Toda-Yamamoto causality tests and cointegration and unit root tests, the question formulated in the second purpose can be answered; in turn, to establish if the variables maintain a long-term relationship.

The respective indicators are estimated with the information of the tables of input - output for Brazil and Mexico in three key years - circa 1980, 2003 and 2013 - and considering compatible disaggregation levels. Data sources to be used are provided by the Statistic and Geography National Institute (INEGI) and the Statistic and Geography Brazilian Institute (IBGE) for the respective years.

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

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## **Implications of clean energy targets for the Indian Economy based on the E3 Model**

Topic: Energy and emissions

Author: Kakali MUKHOPADHYAY

Co-Authors: Partha Pratim Ghosh

Session Title: E3-India: Integrating Energy and Environmental linkages within macroeconomic framework for regional energy policy analysis

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Implications of clean energy targets for the Indian Economy based on the E3 Model

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The government of India through Ministry of New and Renewable Energy (MNRE) is playing a proactive role in promoting the adoption of renewable energy resources by offering various incentives such as generation-based incentives, capital and interest subsidies, viability gap funding, concessional finance, fiscal incentives etc.

The renewable energy's contribution to total energy source in India accounts for 17.5% as of April 2017. India's overall installed capacity has reached 329.4 GW, with renewables accounting for 57.472 GW. A nationwide campaign has been launched to achieve five times more renewable capacity by 2022 and 40% by 2030. The mission also aims to achieve grid parity and parity with coal-based thermal power by 2030 and feed 100 GW of solar power by 2022.

The government has enhanced its aspiration by amending the targets from 40 GW to 60 GW for wind power, 10 GW of biomass and 5 GW of small-scale hydropower by March 2022. Additionally, hydro power and biomass power mandates are set by the government resulting into 175GW of Renewable Energy in 2022. In terms of meeting its ambitious 2022 targets, as of 31 March 2017, wind power was more than halfway towards its goal, whilst solar power was below 13% of its highly ambitious target, although expansion is expected to be dramatic in the near future. Bio energy was at just above 80% mark whilst small hydro power was already 85% of the way to meet its target.

Overall India is at 33% towards meeting its 2022 renewable installed power capacity target of 175 GW. Even though the nation is trying to expand its renewable use, however, country's coal-fired fleet remains strong with a 59 percent share in the total energy mix which is a major source of carbon emission. In this effort, India has voluntarily pledged to the UNFCCC to reduce emission intensity of Gross Domestic Product by 33-35% below 2005 levels in 2030.

Given this backdrop, the current study attempts to evaluate the economic and environmental impacts of the Renewable Energy (RE) by forecasting the likely outcomes at 2035 at national and

regional levels in India using E3 model. For this, several scenarios based on the targets are developed and further compared with the Business As Usual conditions. The results indicate as per the validation exercises, the increases in industrial output and employment as well as reductions in prices of other sectors and carbon dioxide and other GHG emissions. The impacts on fiscal and external balance are also evaluated in order to ascertain the viability of such a growth strategy.

## **Economy wide Assessment of Global Value Chains- Case of China and India**

Topic: Implications of GVCs

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SPECIAL SESSION on "Implications of Global Value Chain"

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### Abstract

Global Value Chains (GVCs) have taken centre stage in the process of development in developing and developed countries alike. China has established itself as the hub of low-cost production in the world and India has also been making tremendous policy shifts to reap the benefits of participating in GVCs. The position of a country in the vertical supply chain has come to dictate the distribution of surplus generated by this process. In this context, research and development (R&D) plays a significant role in productivity enhancement of production processes and is often the source of technology improvement in developing nations. However, the extent of the impact of R&D in GVCs, especially in upstream positions of the supply chain, remains inconclusive. Given the dominant role played by GVCs in the globalization process of economies, both India and China have made significant policy changes for better integration in the same. The participation in GVCs has significant implications for technology improvement and productivity enhancement.

In light of recent developments, focusing on China and India, this study aims to measure the imported intermediate inputs used in domestic processing sectors and the content of imported intermediate inputs in the export basket. The study assesses the R&D content in the imported intermediates and also in export. The study extends its analysis to the environmental impacts on the economies by accounting carbon emissions of imported intermediate inputs and its exports of both economies. Further, it calculates the domestic labour requirement to process the imported input so also export for China and India. The study attempts to address these objectives using the data from GTAP and GVC.

Results indicate the efficiency and the competitiveness of China over India in inter-national trade

in value-added with a deepening of vertical specialization. Overall for both countries, the use of intermediate imports for exports is high although it varies depending on the trading partner. As per the results, R&D embodied in imported input by India is highest in the case of those from the EU and USA. In the Chinese economy, the EU and USA have highest absolute R&D content embodied in imported inputs. Additionally, the trade in intermediate goods appears to have large polluting implications on the economy.

## **An analysis of the regional economic effects of changes productivity in the main Brazilian agricultural crops**

Topic: Feedback Session 1a

Author: Marcos Spínola Nazareth

Co-Authors: Dênis Antônio da Cunha, Angelo Costa Gurgel

The long-term impacts of climate change on agricultural productivity using typically agronomic models are well documented. The existing estimates subsidize the complementary investigations, especially those of economic nature. Thus, the number of researches that seek to extend these impacts to economic variables has increased worldwide recently, given the relevance of this sector to the world economy (Brazil included) and especially due to food security issues involved for the next decades.

However, studies focusing on Brazil based on more regionalized data but linked to the rest of the world using dynamic computable general equilibrium (CGE) models are still very incipient. Therefore, this is precisely the gap that this paper intends to fill, offering a contribution to the debate. Knowing these changes and the consequences for the rest of the economy is essential to map the effects and to elaborate, if necessary, mitigating environmental and economic policies.

Thus, the objective of this paper is to analysis the regional economic effects of the estimated changes in average agricultural productivity for the coming decades using a dynamic CGE model, the PAEGDyn linked to GTAP, for the five major regions of Brazil and to others selected regions of the globe and for the main agricultural crops.

The PAEGDyn is a multi-regional dynamic recursive version of the static PAEG model built on the GTAPinGAMS. The General Economic Analysis of the Brazilian Economy Project (PAEG) is global, multiregional and multi-sector CGE model, constructed for analyzing the Brazilian economy in a regional way, but integrated with the world economy via the Global Trade Analysis Project (GTAP) model and database. Thus the data base includes inter-regional input-output tables with the main agricultural crops disaggregated. Preliminary results show the tropical regions will suffer economic losses vis-à-vis the temperate ones.

## **Impact of Soaring Food Prices and the Pakistan Economy- A CGE Approach**

Topic: CGE & Agriculture and food

Author: Maheen Nazim

Co-Authors: Muhammad Aamir KHAN

Moderate food inflation is highly regarded as a fuel for productivity growth. On the contrary, skyrocketing food prices poses a menace for the economies all around the world. Accordingly,

Pakistan's economy also felt the heat of the world-wide increase in food prices. In the past, supply side factors coupled with demand side factors managed to spur the food prices in Pakistan. Generally, volatility in prices induces the food insecurity which makes the poor segment of the society more vulnerable to food price inflation. This paper intends to supplement the linkage between food inflation and Pakistan's economy. As per conventional wisdom, Hike in food prices can abet or hurt the economy via productivity channel. Either it assists the cultivators by increasing the pay offs to them, or it could lower the yield due to drop in demand. With this backdrop, this study adapted a global economic Trade model that includes more detailed information on

Pakistan household and labour types using latest comprehensive Social Accounting Matrix of Pakistan (2013-14 ) to quantify the impact of Soaring food prices on macro as well at household level in Pakistan. We also empirically analyze the potential benefits of subsidy reforms in agriculture sector to dampen the plausible aftermaths of rising food prices besides accomplishing the inflationary targets of an economy. The overall results show that there will be a negative impact on income of non-farm workers, landless farmers and low skilled agricultural labor of all four provinces of Pakistan. However, there will a positive impact on rural medium and large farmers involved in the production of fruits, vegetables and other agricultural crops. The overall income inequality in Pakistan will increases due to increase in income gap between poor and rich households.

## **The Role of Relative Price Changes and the Structural Decomposition Analysis of the Brazilian Economy from 2000 to 2015**

Topic: Structural decomposition

Author: José Pedro Bastos Neves

Co-Authors: Fabio Neves Peracio de Freitas, Patieene Alves Passoni

The paper aims to evaluate the effect of relative prices changes in structural decomposition analysis in the context of economies such as the Brazilian one in which these changes can be significant. Using an Input-Output updating methodology, we created a series of I-O matrices for the Brazilian economy from 2000 to 2015. The sources of information used in the updating process were the structural characteristics of official 2010 I-O matrix and the partial information for the totals available from the annual supply and use tables at current and last year prices. As a result, we obtained a series of I-O matrices valued at current and last year prices, which allowed us to obtain price and volume indices for each cell of these matrices. The latter indices were used to obtain a series of constant prices I-O matrices. However, the volume figures obtained in this way (i.e., by the use of chained indices) are characterized by the well-known problem of non-additivity. In order to overcome the latter problem in structural decomposition analysis we used the method adopted by Hillinger, Reich, Balk and Diewert to address the non-additivity problem. In our specific application of the method, we deflated the whole series of estimated matrices at current and last year prices by the price index of total gross-output. Then, we isolated the contribution of relative price changes and obtained a more accurate assessment of the real contributions of the factors involved in the gross-output structural decomposition exercise. Comparing the latter contributions to the ones obtained without the isolation of relative price changes, we were able to evaluate the effect of relative price changes. Our investigation revealed that relative price changes have indeed a relatively significant effect on the results of the structural decomposition exercise for the period consider

## **SECTORAL PRODUCTION STRUCTURE OF THE SOUTH COAST OF THE STATE RIO GRANDE DO SUL: AN APPROACH WITH PRODUCT INPUT**

Topic: Sustainable Development Goals

Author: Cassius Rocha Oliveira

Co-Authors: Rodrigo da Rocha Gonçalves

The South Coast of the State of Rio Grande do Sul is formed by the municipalities of Mostardas, Tavares, São Jose do Norte, Rio Grande and Santa Vitória do Palmar and stands out for having an abundance of natural resources with great potential for economic development, especially in relation to water and maritime resources. Faced with this, a question arises: How does the understanding of the productive structure favor the formulation of public policies for the region? The objective of this paper was to estimate an Input Output Matrix seeking to know the economic profile from the analysis indicators. The matrix was regionalized using the Locational Quotient method, starting from a matrix calculated for Rio Grande do Sul in 2011, based on the sector structure in the 2010 Brazilian matrix. Were used data from the IBGE 2011, the Annual Social Information Relation (RAIS) and the National Treasury Secretariat (TSN). The results of the income and employment multipliers indicated that the sectors with the greatest impact were: Forest production, fishing and aquaculture; Storage and Mail; Construction; Trade; Agriculture and pinus planting and Road Transport. With respect to production multiplier, the most representative sectors were: Wood products; Other transport equipment; Other food products; Pesticides; Slaughter and products and Manufacture of chemicals, resins and elastomers. Besides that, key sectors of the region were identified based on linkage indices: Agriculture and pinus planting; Wood products; Construction; Storage and Mail; Water, sewage and waste management; Forestry production, fishing and aquaculture and Other transport equipment. In general terms, activities related to forestry production, port activity and agribusiness are highly representative. From the matrix estimation and the disaggregation of the main activities with the incorporation of a satellite module that evaluates the environmental impacts, the analysis will be the focus of future research.

## **Energy policy and economic growth in Brazil**

Topic: Drivers of energy consumption

Author: Marcela Gimenes Bera Oshita

Co-Authors: Ricardo Luis Lopes

Changes in energy prices and in energy sources can lead to changes in the regional distribution function of real income, given as the problem in the income elasticities of the demand for factors of production of the economies. In this context, knowing the relation of supply and demand of energy with the aggregate product can help countries in the development of energy efficiency policies, thus maximizing the value added of the economy. In this perspective, the objective of this work was to analyze the elasticities between production inputs in Brazil. More specifically, capital, labor and energy. The analysis of the elasticity of substitution or complementarity between energy, capital and labor in Brazil was carried out using estimates of Ordinary Least Squares (OLS) effect fixed panel data. The econometric analysis was obtained using the program Stata13. The sources of variables was based on data extracted from the input-output matrices (2000-2013), in which they were standardized for 44 sectors. The results of the models pointed out that in Brazil energy and capital are substitutes, but energy and labor are complementary. In addition, it has been found that capital and labor are substitutes. The implication of economic is that if capital and energy are substitutes, an increase in the price of energy can lead companies

to invest in capital more efficient, there will soon be an increase in the gross fixed capital formation.

## **Structural Change in the Brazilian Economy: a structural decomposition analysis for the period 2000-2015**

Topic: Feedback Session 2b

Author: Patieene Alves Passoni

Co-Authors: Fabio Neves Peracio de Freitas

The paper aims to analyze the features of the Brazilian structural change process in the period from 2000 to 2015. More specifically, we investigate the intensity and nature of the deindustrialization process in sub-periods of the whole period under consideration. We argue that the deindustrialization process is not as continuous, intense and diffuse as suggested by part of the interpretative literature that covers the period under analysis. In order to overcome some limitations of the indicators used by the later literature (the sectoral gross output, value-added and employment shares), we apply an I-O structural decomposition methodology to examine the contributions of the sources of structural change in the Brazilian economy. We utilize a series of I-O Matrices valued at constant prices constructed by the GIC-UFRJ for the period 2000-2015, based on partial information from the Brazilian SNA and I-O matrix official statistics. Moreover, in our analysis, we regroup the whole set of extractive and manufacturing sectors into four industry groups according to the classification proposed by the GIC-UFRJ: processed agricultural commodities, traditional industry, industrial commodities, and innovative industry. Such classification allows us to interpret some distinctive characteristics of the Brazilian productive structure since it captures specific features of the competition and technological flow patterns prevailing in the Brazilian economy in the period. The I-O structural decomposition analysis of the database described leads us to develop a different perspective in the debate about the Brazilian deindustrialization process. According to this perspective, such process is less intense and continuous than it is usually characterized in the literature. In particular, we show that it is significantly intense in the sub-period after the 2008 world crises and concentrated in the traditional and innovative industries groups.

## **Characterizing the real-financial interconnectedness of an economy: Sector linkage based on IO, SAM and FSAM Multipliers**

Topic: International Finance and Trade

Author: Luis Pedauga

Co-Authors: AGUSTIN VELAZQUEZ-AFONSO

This article goes beyond the traditional analysis of multipliers of Input-Output models by considering the Social Accounting Matrix (SAM) and Financial Social Accounting Matrix (FSAM) multipliers in order to characterize the Spanish economy based upon its sector linkages. Although the SAM have extended the IO analysis of multipliers and is a very useful instrument for economic analysis and evaluation, it is an incomplete tool since that it is limited to the real economy at not including financial ties across sectors, that is, details on the financial institutions and transactions of the agents through its financial assets and liabilities.

The contribution of this article is therefore to provide the FSAM multipliers for the Spanish economy and compare them with the IO and SAM multipliers. This would allow to trace better the real-financial interconnectedness of the economy. This is in line with Shrestha et al. (2012) who

argued that the Financial Stability Board (FSB) and the International Monetary Fund (IMF) have identified as one of the vulnerabilities of the last crisis, the absence of more detailed economic statistics which is due to the lack of prominence that the System of National Accounts (SNA) gives to the from-whom-to-whom principle for data collection and presentation. Particularly, this weakness flourished in the aftermath of the last financial crisis due to the impossibility to anticipate the imbalances between agents in the wake of the crisis which makes evident the need to understand financial interconnectedness among various sectors of an economy and between them and their counterparties.

The FSAM framework could be very useful in overcoming such limitations by allowing identifying which are the sectors that lend or borrow to a particular sector and which are the instruments positions respect to such sectors since that each financial transaction of a sector is mirrored by a financial transaction in other sector. Hence, this article provides a framework that captures the real-financial linkages in order to assess the strength of these linkages in the Spanish economy.

Thus, we compare the multipliers and classify the economic activities based upon their linkages in each model. This allowed us to identify which are the economic activities that remain in their classification across models. We find that half of the activities (37) remain in their characterization. For the rest of the 37 economic activities, the classification changes across models. We provide a detailed analysis on such behaviors.

Finally, we particularly pay attention to the Financial Services Activity what allowed us to deep in the analysis of this productive sector by characterizing it in terms of their linkages. We found that the classification of this sector as a based economic activity is robust across the three models. This result somehow suggests that the financial stability can be related with the bottleneck characteristic of the financial sector which affects all the economic activities as well as the final consumption and investment in the economy.

## **Specialization in Production Networks: Measuring Interdependence in Activities across China's Provinces**

Topic: China's Interregional Input-Output Database: Construction and Applications

Author: Jiansuo PEI

Co-Authors: Quanrun CHEN, Yuning Gao, Gaaitzen DE VRIES

The vertical specialization of countries in trade is by now a major established theme in international economics. A key outcome of this work is that production is fragmenting internationally and countries specialize in activities in global production networks (Baldwin, 2006; Grossman and Rossi-Hansberg, 2008). These activities include production activities as well as various support activities, including pre-production tasks, such as R&D and design, and post-production tasks, such as marketing and after-sales services. We follow Sturgeon et al. (2013) and Markusen and Venables (2013) and will refer to these activities as business functions or in short "functions".

The measurement of vertical specialization in trade initiated with an influential paper by Hummels et al. (2001), who proposed to measure vertical specialization by the import content of exports. Johnson and Noguera (2012) extend this analysis to a multi-country setting by tracing value added in trade based on global input-output tables. Koopman et al. (2014) propose an accounting framework that integrates the measures developed by Hummels et al. (2001) and Johnson and Noguera (2012). In this framework, a country's gross exports are split into domestic value added, foreign value added and (empirically small) "pure double-counting" terms.

The contribution of this paper is to add new information on the functional distribution of jobs embodied in domestic value added exports. We distinguish four functions, namely R&D and



technology development, manufacturing and assembly, sales and distribution, and other support activities. We focus on the job content of domestic value added exports. Los et al. (2015) provide a simple and intuitive approach to measure domestic value added exports and show this measure is theoretically grounded in a Leontief production model.

We identify the job content of domestic value added exports of a particular function by the number of workers that perform the function. For this, we use information on the occupation of workers from the Chinese population censuses. We map occupations to business functions and combine this new and detailed dataset on occupations of workers at the province-industry level with information on inter-industry and inter-regional trade flows from Inter-Regional Input-Output Tables.

The extension of the empirical model for measuring value added trade and the collection of new occupations data allows us to examine specialization patterns of China's provinces in production networks. The standard tool to analyze specialization patterns is by means of revealed comparative advantage (RCA) analysis, which we adapt to perform the RCA on the basis of the functional job content of domestic value added exports of activities. Thus the usefulness of RCA analysis is retained, albeit with a different interpretation. Based on the job content of value added exports in activities, an RCA for a particular activity, say R&D, larger than one indicates that the province in China derives a higher share of its overall domestic value added exports from adding R&D value to its exports relative to other Chinese provinces.

Based on activity shares in value added exports, we analyze shifting patterns of specialization and then explore how the activities in regions are interdependent using spatial econometric analysis. The key idea we would like to explore econometrically here is to examine how regions are involved in production networks and perform different activities. For example, firms in Hebei province might provide production activities for products that are exported from Guangzhou, Guangdong province, whereby firms in Guangzhou provide the logistics activities. Other regions in China's might to different degrees and by undertaking different activities be involved in production networks. Our modeling of such spatial autoregressive relationships would allow us to uncover these linkages.

## **Demographic transition: the impact on Brazilian labor market**

Topic: CGE & Demography

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Demographic changes are affecting direct and/or indirectly the world economy. In Brazil, according to the United Nations (2015) data, the population over 65 years old represented 7.8% of the total population in 2015, and the forecast is that by the year 2030 this frame will reach 13.5%. With a relative increase in the elderly population and a fall in the young population, the hypothesis is that an impact will occur in the labor market and to capture these changes in the economy, a computable general equilibrium model was used.

The model used was called MID (Labor Market-Immigration-Demography-Brazil) which follows the ORANI models (Dixon et al., 1982) of the Johansen type (1960). The model is composed of 62 Brazilian productive sectors that produce one or more of the 128 products from the combination of different inputs and the Brazilian input output matrix of the year 2011 was used. The final demand is made up of investors, families, foreign consumers, government and stock variation. The margins, which have the function of facilitating the flow of domestic production, are composed of 4 types and there are three types of indirect taxes. For production, capital, land and labor are used, which may be Brazilian or foreign, as primary inputs. The composition of the

primary factor there is an imperfect substitution via price, following Armington's hypothesis (1969), controlled by a technology by function CES (Constant Elasticity of Substitution) between capital, labor and land. There is also a substitution between the labor factor that also follows the CES function among workers of different schooling and age group, being, in this way, possible to capture the effect in the Brazilian economy of demographic changes.

It was necessary to calibrate the model with the different substitution of elasticity between Brazilian workers of different age groups and schooling for the 62 sectors analyzed. To do this, the first step was to subdivide the work force into three qualification levels (low, medium and high) and four age groups (young, adult, mature and elderly) in order to calculate the elasticity of substitution of Brazilian workers in 62 sectors using the econometric methodology proposed by Das (2003).

In order to find the workers' elasticity of substitution, the RAIS-Migra database was used, which is a database extracted from the Annual Social Information Relation (RAIS) of the Ministry of Labor and Employment (MTE). The variables used were the worker's income, main activity, besides age and schooling, and the years chosen were between 1997 and 2008, the latter being available.

As a first result it was possible to perceive that the workers present different degrees of substitution, for the different sectors, schooling and age group. In general, it was observed that the young workers have the lowest elasticity of substitution, while the mature ones obtained the highest elasticities. These results show the greater vulnerability of mature workers to being replaced by other age groups. In addition, the result points out that there is an imperfect substitutability among workers and that the demographic transition tends to deepen this effect over the years

After the MID-BR (Labor Market-Immigration-Demography-Brazil) model was calibrated, it was possible to carry out simulations in order to capture the effects that the demographic transition causes in the Brazilian economy. Two studies were carried out, the first being the addition of 1% of the Brazilian labor factor in a homogeneous way.

The uniform increase of workers did not lead to similar variations in the labor price among the age groups, showing, in this case, that the share of older workers had the greatest negative impact on wages. These results take into account the substitution elasticities among the workers calculated in this paper. With the demographic transition that the country undergoes, this result shows that even if the labor growth were homogeneous, as the simulation was carried out, the young workers would be the segment with lower wage losses. The opposite would be the case of older workers, such as the mature and the elderly, who are the fastest growing in the country

The second study had as main objective to compare the influence of workers' schooling on the economy. For this, three simulations were performed and a separate shock of 1% in the labor factor was given in each one of the schooling. It was observed that the increase of 1% of workers with low schooling added 0.2% to the Brazilian GDP. When the increase was for workers of average schooling, the GDP increased by 0.31% and 0.34% for the high. It should be noted that the percentage of low-educated workers, according to RAIS, is 43.3%, 43.7% for the average and 13% for high-income workers. In this way, it was observed that a lower absolute number of highly educated workers leads to greater economic growth in the Brazilian economy.

## **Substitution Process of National Inputs by Imports in the Brazilian Manufacturing Industry**

Topic: Feedback Session 3b

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The Brazilian process of trade opening in the 1990s had an impact on the country's productive activity. As a result, there was an asymmetric integration of the Brazilian manufacturing in the global production. The country has participated much more as a consumer of products from other parts of the international networks of large corporations, to satisfy the domestic market or the regional market, than as a producer. The consequence has been losses of sectorial relations of demand. The purpose of this article is to analyze the losses of sectorial relations of demand in the Brazilian manufacturing industry through a process of increasing substitution of domestic inputs by imported ones from 2000 to 2013. The hypothesis is that Brazil has joined the global value chains in an asymmetrical and subordinate manner. The novelty of this research is the use of the method of structural decomposition of the backward linkages of the Brazilian manufacturing sectors, making possible to visualize if imported inputs reduced the backward linkages of these sectors. The period of analysis is divided into three sub-periods, from 2000 to 2003, from 2004 to 2008 and from 2010 to 2013, which better circumscribe the country's economic performance. The period of 2000 to 2003 corresponds to the period before the commodity boom, in which Brazil had low and unstable economic growth. The second period, between 2004 and 2008, relates to the effects of the improved world scenario for countries exporters of commodities. In this period, the Brazilian economy presented a better economic activity, with the higher economic growth rates of the period of analysis. The year 2009 was not included as it was an atypical year. Finally, the third period, between 2010 and 2013, captures the period in which the global crisis affects the country and Brazil presented a lower economic activity.

The question that emerges is whether Brazil has been inserted in the global value chains through a process of replacing national inputs with imported ones?

We propose to calculate the Ramussen-Hirschman backward linkages, use the structural decomposition of those backward linkages and also calculate imported coefficient of tradable inputs. The Brazilian manufacturing industry is classified according to its technological intensity, using Pavitt (1984) methodology, which classifies the sectors into five categories: intensive in natural resources; labor-intensive; intensive in scale; with differentiated technology and technology based on science. The input-output matrices are deflated using the method of double-deflation.

The analysis is undertaken using the Brazilian input-output matrices with aggregation of 56 sectors for the period 2000 to 2008 and with the aggregation of 68 sector for the period 2010 to 2013, estimated by Guilhoto and Sesso Filho (2010) and based on National Accounts.

The results of this research show that the substitution of national inputs by imported products occurred in Brazil from 2000 to 2013, mainly in the industries of intensive technology in scale and differentiated. The latter were the sectors with greater potential of generating income. There is a correlation between the participation of products with a higher technological intensity and the level of income between countries: in the high-income countries, the medium and high technology sectors accounted for 77.1% of the manufacturing value added in 2010, against 40.5 % in low-income countries (Mazzanti et al., 2015). There is also a growing participation in the industrial structures of industrialized and emerging industrial countries in the sectors of the third industrial revolution: information and communication technologies; and medical, optical and precision equipment. In Brazil, however, the internalization of these sectors was partial and reduced (Sarti and Hiratuka, 2017). This process weakens the links between productive chains, at the same time as the externalization of the domestic market to imports occurs in products of

greater technological intensity.

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## **Assessment of the potential of nuclear energy in reducing CO2 emissions using multisectoral macroeconomic model - the case of Poland**

Topic: Policy Analysis with Interindustry Models

Author: Mariusz Plich

In October 2016 Poland ratified the Paris Agreement of 2015 (PA), which aim is to strive for climate neutrality, i.e. leveling of emissions with the amount of CO<sub>2</sub> absorbed by, among others through forests. This agreement is supposed to protect the climate, and at the same time allows to preserve the specificity of national economies. In the Polish the specificity result from large indigenous deposits of hard coal and lignite. Nowadays still over 80% of electric energy in Poland is generated base on the two most polutogeny of fossil fuels. According to the official government statements a substantial reduction of the emission of CO<sub>2</sub> is possible with use of cutting edge technologies in construction of the new power blocks and sequestration of CO<sub>2</sub> by the forests in the perspective of 30-40 years. At the same time, the high share of coal in electricity production will be reduced systematically by investment in gas turbines, renewable energy sources and nuclear energy. The paper concentrates on the role of nuclear energy in meeting national targets of greenhouse gas reduction. Can nuclear power plant give an important step forward in pursuit of reducing GHG emissions in Poland? This is the main research question of the paper and to answer it, a multisectoral macromodel of Inforum-type (MM model) is developed.

The model is focused on structural changes in the electric energy sector, where nuclear technology is implemented as well as on GHG emissions. In the paper specific problems of the model construction and implementation for Poland are presented as well as preliminary results of scenario analysis assuming various paths of economic development and technological changes.

## **Labor Market Effects of Demographic Transition: a CGE analysis for the Brazilian Economy**

Topic: CGE & Demography

Author: Alexandre Porsse

Population ageing is accelerating in Brazil as consequence of the rapid decline in fertility and mortality population rates over the last decades. According to projections by IBGE, the working age population will start to decline from 2034 and the share of elderly people into population will increase from 6.8% in 2010 to 26.8% in 2060. This paper aims to investigate the extent to which the Brazilian economic structure and growth could be affected by demographic transition considering the transmission effects through labor market. We develop a CGE model where labor is disaggregated by skill and age to simulate the impact of demographic transition on Brazilian economy. The database was calibrated for 2010 and the economic flows are fully disaggregated for 65 sectors. The demographic projections produced by IBGE for the period 2010-2060 are used to estimate structural changes in the composition of labor force in each economic sector and the CGE model is used to evaluate the economic impact of these demographic shocks. The simulations allow to identify which sectors would be more sensitive to demographic transition as well to explore the role of substitution effects on the results.

## **Should subsidies to urban passenger transport be withdrawn? A dynamic CGE analysis for the Brazilian economy**

Topic: CGE & Transport

Author: Andressa Lemes Proque

Co-Authors: Admir Antonio Betarelli Junior, Fernando Salgueiro Perobelli

Brazilian urban transport services are traditionally subsidized and regulated with a price control mechanism by public administration. The subsidies for urban transport contribute to set the prices to below the costs of delivering services and increase in its activity levels, benefiting different customer groups. Change in these urban transport subsidies tends to affect households differently, which present a typical position in the structure of expenditure and income. Poorer households spend relatively more by urban transport. The main aim of this paper is to attempt the effects of a scenario without urban transport subsidies on Brazilian economy and the structural changes on income and expenditure of the household groups. We used a dynamic Computable General Equilibrium (CGE) model with core database based on the 2010 Brazilian Social Accounting Matrix (SAM), detailing the income generation and appropriation by different sources and the spending structure, as well as the preferences of 10 representative households by 4 passenger transport services. The model brings innovations by incorporating SAM flows within its theoretical framework and the detailing of the transport markets in Brazil. With the policy of withdrawal of subsidies and tax exemptions, transport tariffs may have readjustments and become more expensive, harming the poorest households. The main results of the simulations indicate that subsidizing public transport is welfare enhancing. Public subsidy for public transport services is an important measure to facilitate the population access to these services.

## **Soft-Linking Power Generation Optimization Models to Top-down Macroeconomic analysis tools: the case of Egypt**

Topic: Power generation, extractive industries and regional integration

Author: Yassin Yehia Rady

Co-Authors: Matteo Vincenzo Rocco

Traditional bottom-up energy optimization models have been widely applied so far to assess the future electricity technology mix over a specific planning horizon in different regions, assuming various future energy demand scenarios, and quantifying their direct economic and environmental implications. However, such approaches ignore the interactions that the energy sector has with other sectors in the economy, hence failing in quantifying the global – direct and indirect – impact related to future energy technology mix: this may constitute an unfortunate bias in the definition of future energy and environmental policies.

The purpose of this study is to assess and to compare the direct and the total economic and environmental impact due to optimal future energy scenarios in the Egyptian economy, by soft-linking a bottom-up, technology-rich model with a top-down macroeconomic model.

More specifically, the OSeMOSYS energy model is applied to prospective institutional scenarios for Egypt, thus identifying the evolution of the Egyptian electricity production mix towards 2040. These results are then provided as exogenous inputs to a Single-Region Input-Output model (IOA) based on the EORA dataset. Due to the high level of aggregation of the adopted dataset, a robust disaggregation methodology was firstly applied in order to split the energy sector, distinguishing the detailed power generation technologies. Then, the future energy scenario has been applied to the disaggregated IOA model in terms of change in energy technology mix, change in final demand of electricity and change in national GDP production. Beside the results of the energy model, this approach enables to assess the expected primary energy requirements, GHG emissions and water use induced by the evolution of the energy mix in a broader national perspective.

It is found that Combined Cycles, Wind and Photovoltaic rooftop systems are competent to be included in the future Egypt's future power generation mix. However, the direct primary energy consumption and GHG emissions by the electricity production sector remain approximately constant according to the results obtained by OSeMOSYS, a significant reduction, driven by production sectors other than electricity generation, in the total energy requirements and GHG emission is realized. In addition, there is an opportunity for the decoupling of the GDP growth and the embodied emission within the Egyptian economy, as the prospective production mix will include a high efficient and less polluting power generation technologies.

## **Gender pay gap in global trade: How pervasive is gendered labour inequality?**

Topic: Gender and inequality

Author: Rachel C. REYES

Co-Authors: Muhammad Daaniyall ABD RAHMAN, Futu FATURAY, Manfred LENZEN, Joy Murray

To help address the increasingly recognised issue of gender inequality, as underscored in the 5th Sustainable Development Goal (SDG) of the UN, we investigate the extent of women underpayment and their underrepresentation in employment. We provide a quantitative response to the question: How pervasive is the gendered labour inequality in global trade in terms of pay

gap? Using the multi-region input-output (MRIO) framework, we calculate gender pay gap footprint that embodies the cost avoided by producers for paying female workers less than the males. In this work, we examine gendered wage-unfairness at the meso and macro level, i.e., sector and country levels. First of its kind, we combine and harmonise gender pay gap data and pay gap-related information from the International Labour Organization (ILO), Eurostat, country statistical agencies and reports, the World Economic Forum's The Global Gender Gap Report and the African Development Bank's Country Policy and Institutional Assessment report, as well as labour data from the ILO, with Eora's MRIO model to trace gender pay gap throughout the global supply chains and reveal the pay disparities implicated by consumption of commodities in distant regions. We find substantial aggregated pay differences to be attributable to large-producing, large-consuming, high-income countries [e.g., USA (imports and exports of wholesale and retail goods), Japan (wholesale trade exports) and Germany (machine exports)] and the services sector to have the highest nominal pay gap in total. Greater per capita net trade of pay gap and pay gap per worker are also primarily observed among developed countries since they remunerate workers at relatively higher rates than developing countries. But with the ultimate metric of gender pay gap footprint, the ratio of female underpayment relative to male earnings, the typically observed rich country/poor country divide found in previous environmental and social assessments does not appear to hold true (e.g., Pakistan and South Korea as net exporters, Bangladesh and Sweden as net importers). We also find that whilst in many cases a high-gap/low-female employment situation occurs in the producing economy, low wage gaps in some instances mask gendered labour inequality for countries that employ very few women. We suggest that our work is valuable in informing the fair-trade agenda as well as global action and policy on gender equality to speed up the process for women to attain economic parity.

## **Winds of Bahia: an analysis of the socioeconomic impacts of wind farms in Bahia municipalities**

Topic: Feedback Session 2a

Author: CAROLINA SILVA RIBEIRO

Co-Authors: Gilca Garcia de Oliveira, Roberto Maximiano Pereira

The state of Bahia has a significant wind power potential, estimated at 195 GW for a height of 150m, is the leader in the contracting of wind energy in Brazil and has 21 municipalities with projects in implementation. Unlike the other states of the Northeast region, which has a higher incidence of coastal winds, Bahia concentrates its wind potential in the interior, more specifically in the semi-arid region that suffers from a scarcity of rainfall. In this sense, it is questioned how the implementation of wind farms in Bahia municipalities assists in the sustainable development of the semi-arid Bahia? Thus, this work seeks to evaluate the socio-economic impacts of the implementation of wind farms in Bahia municipalities with the advent of wind activity in the State. To do so, it uses the input-output matrix estimated by the Superintendency of Economic and Social Studies of Bahia (SEI) for the year 2015. The analysis will be based on an exploratory study of the impacts of wind activity in the sectors of economic activities inserted in the State of Bahia, through the use of input-output indicators (as a key sector, economic multipliers of employment and production, indices of Rasmussen-Hirschman intersectoral links, field of influence and hypothetical extraction of sectors), in order to investigate the creation of jobs and production associated with wind farms and, in turn, the wind energy production chain. The study will show how total production is used and how much direct and indirect jobs have the potential to generate by wind activity and its productive chain. The results of this article will enable us to understand how wind energy can make a significant contribution to the generation of jobs in several rural areas, promoting local and sustainable development.

Keywords: Socio-economic Impacts; Wind farms; Input-output; Sustainable development. Semi-arid region

## **AN INTER-REGIONAL NETWORK PERSPECTIVE TO EVALUATE THE BRAZILIAN ECONOMY**

Topic: Network and other analysis

Author: Luiz Carlos de Santana Ribeiro

Co-Authors: José Garcia Vivas Miranda, EDER Area Leão PEREIRA, Hernane Borges de Barros Pereira, Fernando Salgueiro Perobelli

Since the publication of Wassily Leontief's seminal work, input-output (IO) models went through by several improvements and extensions. In an attempt to proposing new ways of assessing sectoral interdependencies, integration with other models has been extensively explored in the specialized literature. In this regard, this paper aims to deepen the discussion about the productive interdependence among the Brazilian states through integration between an IO model and complex network theory and identify emergent patterns or properties within the Brazilian states. To do so, an inter-regional IO matrix, base year 2008, is used for the 27 Brazilian states and 26 sectors. The main results indicate that the sectors with the highest centralities degree and weighted degree belong to states of the Southeast region, that is, São Paulo and Rio de Janeiro, mainly, and Minas Gerais. In addition, most of these activities are linked to industry, except for two service sectors: Transport, warehousing and mail and Private services. Economically speaking, this means that these sectors have a significant amount of intersectoral trade relations in Brazil. It is worth mentioning that the out degree of these sectors was greater than the in degree, which reveals, for this group of sectors, a greater relative importance on the supply side of the economy. Oil refinery, coke and alcohol of Bahia is the only Northeast's sector that stands out considering the degree measures. This can be justified by the presence of the Petrochemical Complex of Camaçari, which places Bahia as an important supplier of petroleum refining products in both regional and national terms.

## **Beyond Well-to-Wheels analysis: assessing the full supply chain impact of Fuel Cell Electric Vehicles (FCEV) in future automotive scenarios**

Topic: Life-cycle analysis

Author: Matteo Vincenzo Rocco

According to projections of International Energy Agency, to comply with the European GHGs emission target, the provisioned penetration of Fuel Cell Electric Vehicles (FCEV) is estimated as the 30% of the total passenger light-duty vehicles in 2050, implying a massive production of Proton Exchange Membrane Fuel Cell (PEMFC) for the next decades, as well as an extensive penetration of hydrogen production facilities and distribution infrastructures. Traditional Well-to-Wheels (WtW) models are capable to assess the primary energy requirements and the emissions of the prospected transition focusing on the fuel pathways, but, compared to Life Cycle Assessment (LCA) models, they neglects the physical infrastructures required to support such new technologies, namely the fabrication of the vehicles and the fuel distribution infrastructures, and also neglecting the indirect effects due to the prospected changes in the national energy sector.



The objective of this research is to evaluate the economic and environmental impact of the penetration of FCEVs in the German transport sector in 2050, focusing on CO<sub>2</sub> emissions and primary non-renewable energy consumption. The LCA analysis is based on an Integrated Hybrid Input-Output model: the background system (supply chains) has been modeled through the EXIOBASE database, while the foreground processes have been characterized based on the Authors' experience in Fuel Cells technology, an in-depth literature surveys and the support of the Ecoinvent® database. The main exogenous scenario parameters are related to the prospected shares of FCEV in the automotive technology mix, different hydrogen production and distribution processes, and different electricity production technologies. In addition to the hydrogen production and use phases, the developed LCA model also includes the production of vehicles and infrastructures for hydrogen production and distribution, and the prospected change in the national electricity production mix.

Significant discrepancies have been found by comparing results of WtW models and the developed LCA model: in particular, it is found that the impact caused by infrastructures and vehicles production could significantly offset the expected reduction in CO<sub>2</sub> emissions by about 30% and primary energy consumption by about 10%.

## **Modeling the location choice: evidences from an evolutionary game based on regional input-output analysis**

Topic: Feedback Session 4a

Author: Ademir Moreira Rocha

Co-Authors: Douglas Sad Silveira, Fernando Salgueiro Perobelli, Silvinha Pinto Vasconcelos

This article proposes a new methodology to analyze the strategic decision about firms location choice. In this way, we combine the Evolutionary Game Theory (EGT) approach with input-output analysis. As the location pattern of firms that compete in the automotive sector of Mercosur countries has not been widely debated yet, that specific region was chosen to empirically describe and evaluate our model. By doing so, Mercosur was separated into two strategic regions: Brazil and Rest of Mercosur. To decide where to locate, firms consider the following exogenous factors: (i) potential market; (ii) local productive interdependence; (iii) government tax incentive and (iv) macroeconomic stability. To generate the results, we create hypothetical scenarios, in which firms can assign specific weights to each of these factors in the decision-making process. The outcomes suggest that, when companies give homogeneous weights to these factors, the balance occurs with the two competitors in the market where there was the governmental tax incentive. On the other hand, if factors are assigned with different weights, the long-term equilibrium of the game changes, which provides evidence that competing in the market where there is a tax exemption is not always an ideal location decision. That is, the other factors are relevant in the decision making of the firms. This may contradict common sense, which presupposes a direct relationship between government incentive and attraction of firms to a region.

## **Economic Structure Analysis for Brazil, India, Russia and China (1995 - 2011)**

Topic: Structural change

Author: Caio Bertoni Viana Rocha

In the structuralist tradition, the economic structure of a nation plays an important role in setting the grounds for its growth and development. A well known and robust stylized fact that comes from this tradition is that the relocation of economic activity out of agriculture is highly related to growth.

Taking this fact as true, this paper aims to provide a comprehensive view of the changes in the economic structures for a set of developing countries (Brazil, India, Russia and China) using data from the World Input Output Database (WIOD) for the period from 1995 to 2011.

The method used for structural analysis is based on the work presented by Syrquin in 1988. In this paper, the focus is on employment and value-added dimensions. Data is presented from three different points of view: aggregated sectors (Agriculture, Industry and Services), subsectors in Industry aggregated sector and subsectors in Services aggregated sector. Therefore, the paper covers both general and specific characteristics of national economic activity.

Inspired by the work of Memedovic and Lapadre presented by UNIDO in 2009, this paper strives to broaden the structural analysis by providing value-added information both for real and current prices and by bringing the Services subsector data into light.

## **ACCESSIBILITY IN THE REGIONAL CGE FRAMEWORK - SHORT AND LONG TERM EFFECTS OF TRANSPORT INFRASTRUCTURE INVESTMENT IN POLAND**

Topic: CGE & Transport

Author: Bartłomiej Rokicki

Co-Authors: Marcin Stepniak

Since its EU accession, Poland has invested strongly in development of fast road transport network. As a result, the total length of modern, high-speed roads has increased from around 500 km in 2004 to almost 3000 km in 2014. Yet, while the positive impact of transport infrastructure investment on overall accessibility is unquestionable there are no studies that assess its influence on economic development of particular regions.

This paper applies regional dynamic CGE model to measure the effects of big transport infrastructure investment between 2004 and 2014 in Polish NUTS2 regions. We use the data on both investment spending and accessibility improvement (expressed as a reduction in travel time) in order to distinguish possible short and long term impacts. Based on counterfactual analysis, we find that while positive these impacts are highly nonlinear and differ strongly across the regions.

## **Measuring bilateral trade in terms of value added**

Topic: Value Added in Trade and the OECD ICIO

Author: José M. RUEDA-CANTUCHE

Co-Authors: Iñaki Ignazio Arto, Erik DIETZENBACHER

The increase in the fragmentation of production across countries and the subsequent growth in the trade of intermediate products have raised concerns about the suitability of conventional trade statistics to understand the economic consequences of trade. Several authors have attempted to disentangle value added content of trade. None of the suggested approaches, however, has been able to: (1) fully decompose the factor content of bilateral trade measured at the border; and (2) account for the role of the different countries and industries participating in the global value chain. In this paper we propose a novel framework that enables these two analyses. Furthermore, because of the country and industry detail of our approach, we are also able to provide a new extension of the standard value added to exports ratio.

## **From theory to practice: what makes the European Union's Inter-Country Supply, Use and Input-Output tables different?**

Topic: SUT compilation: experiences from NSOs

Author: José M. RUEDA-CANTUCHE

Co-Authors: Isabelle REMOND-TIEDREZ, AGUSTIN VELAZQUEZ-AFONSO, Pedro MARTINS FERREIRA, Paola Rocchi, Juan Manuel Valderas Jaramillo, Antonio F. AMORES, MARIA VICTORIA ROMÁN

The Eurostat-JRC project "Full International and Global Accounts for Research in Input-Output Analysis" (FIGARO) has produced experimental EU-Inter Country Supply, Use and Input-Output Tables for the year 2010 in line with the ESA 2010 methodology. Setting up a European Inter-country Supply, Use and Input-Output Table implies the compilation of a balanced view of international trade consistent with National Accounts data. It is therefore absolutely necessary to: (a) reconcile the trade asymmetries and provide one single trade flow for each bilateral transaction between partners; and (b) align the trade figures with National Accounts data, in order to capture, for instance, the potential environmental, social and economic effects of supply and demand shocks on the national economies via the existing global value (and supply) chains. The paper describes methodological issues raised by the construction process of the Inter-country Supply, Use and Input-Output Tables: e.g. econometric estimations of cif/fob margins; econometric estimations of missing bilateral services trade; alignment of trade statistics and national accounts data: e.g. goods sent abroad for processing, merchanting activities.....

## **Employment effects of EU services exports to the rest of the world by modes of supply using the Eurostat's EU Inter-country Input-Output Tables**

Topic: GVC Trade

Author: José M. RUEDA-CANTUCHE

Co-Authors: MARIA VICTORIA ROMÁN, Antonio F. AMORES, Juan Manuel Valderas Jaramillo, Isabelle REMOND-TIEDREZ

Services are increasingly delivered across borders under various modes of supply and gaining

higher shares over all the economic activities. However, the availability of statistics on the international supply of services detailed by services category, mode of supply and partner country is limited and at the same time critically important for trade policy making. Based on the most recent Eurostat published data, this paper presents the first attempt to estimate the employment effects by modes of supply using official statistics and the Eurostat's experimental EU Inter-country Input-Output Table (FIGARO Project).

## **Making the circle square: treatment of goods sent abroad for processing in the construction of the European Union's Inter-Country Supply, Use and Input-Output tables**

Topic: Management of Globalisation in the National Accounts and Implications for Input-Output Tables and Analyses

Author: José M. RUEDA-CANTUCHE

Co-Authors: AGUSTIN VELAZQUEZ-AFONSO, Paola Rocchi, Isabelle REMOND-TIEDREZ

The extension from national to inter-country Supply, Use and Input-Output tables (SUIOTs) consists in splitting national SUTs domestic exports (FOB) by country of destination (and importing industry) and by type of use (intermediate or final), which in turn produces indirect estimations of imports of intermediate and final goods and services among countries of origin (and exported products). It could also be the other way round, splitting national SUTs imports by countries of origin, as in the WIOD approach. The two approaches should not differ, in principle, as long as the view of bilateral trade among countries is balanced at the level of each good and service and both exports and imports are valued in FOB. However, this is not the case in official statistics, mostly due to trade asymmetries and the different valuation of exports (FOB) and imports (CIF). This paper however justifies the first choice for various reasons and put a special focus on the treatment of goods sent abroad for processing, including some indications about the necessary assumptions made in the absence of official data about trading partners and type and destination of the processed goods.

## **QDR methodology: understanding bilateral trade flows in the European Union**

Topic: Network and other analysis

Author: José M. RUEDA-CANTUCHE

Co-Authors: Pedro MARTINS FERREIRA, Isabelle REMOND-TIEDREZ

Trade asymmetries have been a well-known fact and there is extensive literature and many reports about the causes for those asymmetries. There is also a recognised effort made by trade statisticians for mitigating trade asymmetries over time. Notwithstanding the positive achievement that have been made so far, that is not enough to build a European Union Inter-Country Supply, Use and Input-Output tables (EU IC-SUIOT), i.e. trade asymmetries must have been removed completely and a balanced view of trade must be estimated as well.

Another problem is about the correct identification of the countries of origin and destination from the ownership perspective. The European Statistical System (ESS) has an extensive and rich amount of trade data and a lot of resources are devoted to measure trade flows. Nevertheless, the customs union of the EU adds another challenge regarding trade in goods statistics: Member-States declare imports/exports for customs or tax purposes without this Member State

having acquired ownership of the goods, i.e. declare quasi-transit as well. While relevant for physical flow of trade, quasi-transit and re-exports distort the geographical economic relationship among Member-States and therefore they should be identified and taken into account in the framework of the EU IC-SUIOTs.

To solve these two problems, we have developed the so called QDR methodology in order to address the specificities of trade in goods in the EU by providing a way to estimate balanced trade flows, i.e. solving trade asymmetries, between two countries by three types of international trade: quasi-transit (Q), domestic exports (D) and re-exports (R). For quasi-transit and re-exports the intermediary country between origin and destination is also identified. The QDR methodology was used in the FIGARO project and it revealed very useful for identifying relevant trade relationships across countries.

## **THE EFFECTS OF NAFTA ON CANADA, MEXICO AND THE UNITED STATES: A MUTIREGIONAL INPUT-OUTPUT ANALYSIS**

Topic: GVC Trade

Author: Pablo RUIZ NAPOLES

Co-Authors: Eduardo MORENO REYES

The North American Free Trade Agreement has been studied from various angles and for various purposes in its 23 years long history. The US administration that inaugurated last year, opened the renegotiation of this agreement, on the basis of its being unfair to the US, mainly because of US companies establishing plants to produce and export in Mexico, generating for Mexico a trade surplus in the area, which translates in a US trade deficit, the third largest in US trade statistics. This has been said to damage also the domestic level of employment in US manufacturing sectors. The renegotiation rounds are already on their way. However, a precise measure of this supposed “damage” to US labor caused by Mexican exports is still missing, nor is it clear how many and what sectors have been damaged.

Relatively recent developments in Multi-Regional Input-Output Analysis (MRIO) helped to produce a study for the European Community, published in 2015, like the one we propose to do for NAFTA. Our study is aimed to answering two basic questions: (1) which have been the results, positive or negative, of the operation of NAFTA for each of the three economies involved; (2) what sectors in each economy have been most benefited or damaged by NAFTA in each of the three economies. Thus, the objective of this particular study is to build and use a Multiregional Input-Output model for the Northamerican region: Canada, Mexico and the US, to determine the effects of NAFTA for trade, income, output and labor in each of the three economies.

The study features a series of indicators to illustrate in detail the relationship between trade, employment and income for NAFTA as a whole and for each NAFTA member state using the World Input-Output Database (WIOD) as the source for the main data. Other data will be collected from OECD or from local sources (INEGI for Mexico, DOC for the US, etc.). The idea is to cover all NAFTA period, 1994 to the present as long as possible.

## **The network of inter-industry flows in a SAM framework**

Topic: Network and other analysis

Author: Susana Santos

Co-Authors: Tanya Araújo

The networks of nominal flows between industries in a Social Accounting Matrix (SAM) framework are studied.

The flows of the SAM submatrices of production (or output of goods and services) and intermediate consumption, constructed from the supply and use tables of the national accounts are identified. From those flows, the inter-industry networks are induced. The structure of these networks are analysed, as well as, the underlying generation of income and the correspondent functional distribution.

An application to Portugal illustrates the approach.

## **NIOT in Latin America: comparison of data available of based on Brazil**

Topic: Development of Input-Output Benchmark Accounts

Author: Marianela SARABIA

Development of IO data has been widely enforced during the last decade. Indeed, many IOT have been generated during this period with their own specificity according to each project purpose and harmonization needed. Since in Latin America, Brazil is one of the countries ahead in generating and updating its IOT, this article is aimed at identifying and comparing all these sources of information taking the Brazilian NIOT as a case for learning about all these data sources with a regional perspective. In other words, it is aimed at gathering and comparing Brazilian NIOT according to data available in order to identify possible schemes of IO analysis with focus on Latin American countries. Therefore, first, we present and compare the NIOT elaborated by the IBGE for 2005 -with activities' aggregation to make it compatible- with the analogous NIOT from the following sources: the first version from WIOD project, the latest version of ICIO/OECD and that estimated by ECLAC for the South American IOT, in which 2005 constitutes the based year and the only one available. Later, we introduce a similar work based on the NIOT for 2014 coming from the recent data published by the IBGE and the latest version of WIOD, which last year is 2014. After that, we present an application for 2014, based on the two sources to learn how sensitive interindustry linkages can be to sectoral breakdowns. Finally, the appendix describes main changes between ISIC Rev 3 and Rev 4, related to methodologies and activities classification for 2005 and 2014, respectively.

It would be great to present Wednesday or Thursday. Thanks!

## **About the possibility of taking into account the updated data in the Russian block of World Input-Output Tables**

Topic: National data in Global IOTs

Author: Alsu SAYAPOVA

Co-Authors: Nikita Andreevich Skripnik, Tatiana O. TAGAEVA

In the international databases of the world input-output tables, the Russian block is statistically represented very weakly. Even the developers of the updated version of the WIOT database do not advise using a diagonal Russian block for analyzing the Russian economy. The reason for that is a poor database of national input-output tables for Russia. However, after an interval of almost 20 years, a one-time-only survey of production costs structure was carried out for Russia and an input-output table for the year 2011 was constructed. Unfortunately, the publication of the tables was conducted after the WIOD database was updated, so new Russian data were not included in this version. In addition, the Russian tables are made in the old version of ISIC, which was used for the world tables of input-output for 1995-2011. We have attempted to include the updated data for the Russian block for 2011 into the world input-output tables. For this purpose, based on the supply table and the use table for the domestic products, a block (industry by industry) of intermediate consumption of domestic products is calculated. Preliminary calculations show that the difference with the previous version of the Russian block and the new one, taking into account the results of the recent survey of the cost structure in the Russian economy, are significant. In some industries, the intermediate demand for domestic products is differs several times from the one from previous version. Differences can be seen not only in intermediate demand, but also in the output of industries. Therefore, when adapting to the new structure of costs, most attention is paid to the input-output coefficients. For balancing, the RAS method and optimization methods are used. A comparison of the results of the scenario analysis, based on different variants of the input-output coefficients, is carried out.

Keywords: one-time-only survey of production costs structure, updating of diagonal blocks of world input-output tables

## **Macro-Economic Impact of MGNREGA in India: An Analysis in CGE Modeling Framework**

Topic: Feedback Session 2a

Author: Akhilesh Kumar Sharma

Co-Authors: Atul Sarma

The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) is one of the flagship programmes of the Government of India. The programme aims to deal with rural poverty and unemployment by assuring economic security to the rural poor, by providing guaranteed wage employment when other employment alternatives are scarce or inadequate. This study aims to evaluate the macroeconomic impacts of the MGNREGA on the Indian economy by running counterfactual simulations with the aid of PEP-1-1 CGE model. The findings indicate that MGNREGA has increased the real GDP of the economy as well as household income and real consumption budget. The increase in household income is higher for the bottom quintile classes in comparison to the richer households. If the MGNREGA expenditure is reallocated to educational services, medical services, and public administration, the GDP of the economy as well as household income will decline.

## **Modeling Economic Impact of IFC Infrastructure Projects**

Topic: Investment and capital formation

Author: Evgenia Shumilkina

Co-Authors: Shoghik Hovhannisyan

Infrastructure projects account for a substantial share of portfolio in the multilateral development agencies including the International Finance Corporation that allocated nearly 26 percent of total investment to ports, roads, and power sectors during 2014-2016. Investment in infrastructure generate additional growth effects compared to the real sectors of the economy such as manufacturing, agriculture, and services as they relax acute infrastructure constraints in developing countries and enable economic expansion. This study contributes to the existing literature in three main ways. First, it proposes methodologies to estimate the development impact of infrastructure projects in roads and ports focusing on forward production linkages in addition to effects stemming from the construction, operation, and maintenance widely discussed in the literature. With growing GDP, capacity constraints in roads and ports might hinder the economic development of countries. This study uses increased traffic including export, import, and domestic flow of goods enabled by infrastructure projects to compute the demand shocks to the economic sectors and economy-wide effects based on the Social Accounting Matrix (SAM) multiplier approach. In addition to the increased traffic, the paper computes economic impact of cost and time savings associated with the projects. Second, the proposed methodologies rely on various empirically estimated inputs such as import-GDP elasticities to enrich the methodologies with elements outside of the SAM multiplier setup. Finally, these methods suggest a new way of computing the job creation across countries based on empirically estimated GDP-employment elasticities. The paper uses data on traffic, capacity, costs and time savings from IFC projects, SAM tables from the Global Trade Analysis Project (GTAP), and GDP, inflation, and employment from the World Development Indicators.

## **Productive Integration and Locational Advantages: The Brazilian Agribusiness Value Chains in Comparative Perspective**

Topic: GVC upgrading

Author: Izak Carlos Silva

Co-Authors: Weslem Rodrigues Faria, Fernando Salgueiro Perobelli

Due to the climate and soil conditions, in line with funding and research policies, Brazilian agribusiness presents with great weight the economic activity of the country, creating an average of 20% of the national GDP in the last 20 years, besides representing more than 35% of Brazilian exports. At the same time, the emergence of global value chains and the great fragmentation of production around the world have altered the global patterns of productive integration, influencing production, international trade, domestic value added, productivity, employment and distribution of income.

Given the importance of agribusiness to the Brazilian economy and having in view of the new productive conformation, the objective of this article was to analyze the degree of productive integration and the Brazilian locational advantages for the specialization in the agribusiness value chains, defined in a pioneering way based on the hypothetical extraction of the Brazilian input-output matrix from the Agriculture, Hunting, Forestry and Fisheries sector (S1), with the opening of 35 sectors between 1995 and 2011. They were defined as sectors belonging to the chains of Brazilian agribusiness, the sectors with above-average total production as a reflection of



the hypothetical extraction of purchases and sales of the Agriculture, Forestry, Hunting and Fishing (S1) sector, or sectors immediately below the average in specific periods, but with tenacity in their longitudinal production variations, for which the value-added rate was calculated on the exports Gross (VAX rate), the index revealed comparative advantage in terms of value added (VARCA). For both coefficients the shift-share was applied, in order to capture the locational advantages of productive integration and specialization in these sectors.

From the indicators of integration, specialization and locational advantages to specialization, we sought to understand how Brazil was associated with this productive conformation of the Global Value Chains in relative terms, that is, the coefficients were normalized so that Brazil represented the unit and the other WIOD countries were positioned in terms relative to Brazil, allowing comparison. The results indicated that Brazil, in perspective to the other sectors of the other countries, has high productive integration and wide locational advantages for the specialization in several sectors of agribusiness value chains, even in the most dynamic sectors.

## **Trade-offs between environmental pressures and economic benefits in primary commodity exporters: a study of Australia and Brazil from 1995 to 2015**

Topic: GVC Trade

Author: Moana SIMAS

Co-Authors: Thomas O. WIEDMANN

During the past two decades, the transfer of environmental pressures embodied in traded products has increased, mainly due to the greater participation of developing economies in global exports. At the same time, value added and jobs associated to GVCs have also increased, and exports have contributed to economic development in many countries. However, few studies link the socioeconomic gains of these exporting countries with the environmental pressures embodied in supply chains. It is clear that the study of the transfer of environmental externalities cannot be dissociated from socioeconomic gains in exporting countries, and it is important to assess the trade-offs between these gains and environmental pressures if we are to promote sustainable development. Among the countries which depend on resource intensive exports (over 50% of raw- and low-processed products from agriculture, forestry and mining) and significant participation in GVCs, Australia and Brazil rank in the top.

We ask the following questions:

- 1) How do economic and environmental pressures compare for production- and consumption-based accounts for both of the countries, and how has this changed over time?
- And 2) What are the trade-offs between economic gains and environmental pressures of the specialization in resource-intensive exports, and how has this changed over time?

We used EXIOBASE 3, an MRIO database which covers 44 countries plus 5 Rest of the World regions, 200 products, and a time series from 1995-2011 plus a nowcasted series from 2012-2015. We analyzed value added, labour, GHG emissions, land use, water use, and domestic material extraction embodied in consumption, imports and exports. We also calculated resource productivity from a production and consumption perspective throughout the period, and measured trade-offs as the economic gains (value added and labour) per use of resources (environmental pressures) in the domestic economy, exports and imports.

## **A supply-use approach to capital endogenisation**

Topic: Investment and capital formation

Author: Carl-Johan H. SÖDERSTEN

Co-Authors: Manfred LENZEN

Input-output (IO) analysis currently treats capital transactions as exogenous components of the inter-industry system despite that capital goods are ultimately used in the production of further goods and services for final demand. This implies that footprint-type analyses that make use of the Leontief inverse do not take into account the emissions embedded in the capital that is used in the production processes. It has therefore been suggested that capital transactions ought to be endogenised into the IO framework, so that the effects of building up and maintaining capital are included in impact assessment calculations.

Two methods have previously been used to close the IO model for capital transactions: the augmentation method and the flow matrix method. Both methods entail the addition of capital flows into the inter-industry matrix. In Leontief's demand-pull model, the calculation of multipliers requires an inversion of the requirement matrix, which implies that the differentiation between capital goods and non-capital goods can no longer be made when associating stressor intensities to the multipliers. Moreover, the inversion requires that the tables be symmetric, and the conversion from supply-use tables (SUTs) to IO tables (IOTs) therefore entails the use of a construct that decides upon the resolution of the IOTs (e.g. product-by-product or industry-by-industry) as well as the method used to handle e.g. by-products.

In this paper, we follow the supply-use formalism that Lenzen and Reynolds (2014) used to develop their Waste Supply-Use Tables (WSUT), but rather than endogenising waste flows, we endogenise capital flows. We introduce the capital supply-use tables (KSUTs) that allow us not only to keep full transparency throughout the process of calculating multipliers, but also to differentiate between products and industries when performing impact analyses as well as separating between capital goods and current intermediate goods. Hence, the results will enable a more specific interpretation of results, and ultimately, we are able to resolve the dilemma of assigning different stressor intensities to goods belonging to different age cohorts. We demonstrate the relevance of our contribution by providing a small-scale numerical example of our KSUT framework using data from the EXIOBASE 3.3 and EU-KLEMS databases and end by showing how the framework could be extended to large-scale MRIOs as well.

## **Exploring Mitigation Options in Agriculture Sector and links with SDGs: Some Empirical Evidences from India**

Topic: Sustainable Development Goals

Author: SHREYA SOME

Greenhouse gas emission mitigation is one of the globally accepted goals of sustainability (SDG 13). Opportunities for mitigation in agriculture; an emerging cost-effective mitigating sector (FAO, 2017) includes both supply-side and demand-side options. For example, supply side actions take into account reduction of GHG emissions per unit of output produced whereas demand-side actions include change in consumption patterns (Bellarby et al. 2013; Bajzelj et al. 2014) keeping in mind the nutritional needs of the population. Literature suggests pursuing these climate-mitigation options have several other non-climatic but development related co-benefits (IPCC 2014c), predominantly SDG 1,2,3,6,12,14 and 15. Literature review shows chances of both

positive and negative impacts (Behnassi et al.2014; Godfray and Garnett 2014; Campbell et al. 2014; Lipper et al. 2014; Long et al. 2016; Karnib 2017). Quantification of the net impacts is a knowledge gap in the literature. There are potentially many barriers to implementation of these options, including accessibility to adequate financing, poverty, institutional, ecological and technological barriers. Nevertheless, the national governments of developing countries like India are relying on various alternative development trajectories in order to make their contribution towards achieving sustainability in agricultural sector. Conceptually it is possible to apply Input-Output technique in understanding direct and indirect impacts using various metrics such as employment multipliers, energy multiplier, income multipliers and so on. However, the current paper covers two steps: first it develops the link between mitigation options and the individual SDGs based on available literature and tries to assess the direction and strength of the links. Second, it uses Kaya identity to understand drivers of emission for Indian agriculture sector to identify the major climate mitigation response strategies. Eventually a third step will be towards quantification of SDG links.

## **Incorporating Port-Level Foreign Trade Data into IMPLAN's Gravity Model to Estimate Region-Specific Foreign Trade Rates**

Topic: Regional trade

Author: James James Squibb

Co-Authors: Jennifer Thorvaldson

Understanding regional participation in international trade is important for state and local policymakers, but useful empirical estimates are often unavailable. This paper describes a new method that incorporates foreign trade data tabulated by customs port into a gravity model of regional trade in order to allow for regionally-specific foreign trade rates and identification of foreign country-level trading partners by commodity at the subnational (county) level. The paper begins with an overview of the gravity model. It then describes the methods used to incorporate the port-level foreign trade data into the gravity model, and finally compares results to existing alternative methods.

This paper uses port-level data, as reported by the United States Census Bureau, on foreign exports and imports of shippable goods (aggregated to 366 commodities) to decompose national foreign imports and exports to the county level (the United States had 3,141 counties in 2015) while maintaining consistency with estimated regional gross supply and demand by commodity. It then further decomposes those trade estimates by country-level trading partner. Estimates of county-level gross commodity supply and demand, as well as gravity model calibration parameters, are based on IMPLAN's 2015 dataset for the United States. National-level estimates of supply, demand, and foreign trade of commodities are derived from U.S. national accounts published by the Bureau of Economic Analysis. This results of this method are compared to two common alternatives: 1) subnational decompositions of foreign trade that rely on fixed import and export rates (the method currently used by IMPLAN, in which, for example, each county that produces a given commodity would export that commodity abroad at the same rate as the U.S.), which may be overly simplistic, and 2) state-level data tabulated by origin of movement or state of destination, which may not coincide with place of production or consumption (or use).

## **Integrating ecological systems into input-output analysis: the importance of feedback loops**

Topic: Feedback Session 1b

Author: Emily Stebbings

Co-Authors: Melanie Clare Austen, Tara Hooper, Eleni Papathanasopoulou, Xiaoyu Yan

The Blue Economy is an important driver of economic growth in the EU. Input-Output (IO) valuation methods have been long established for consumption-based environmental impacts such as GHG emissions, and more recently for fisheries. An increased emphasis on ecosystem based management approaches in policy and decision making has led to greater demand for integrative economic models. Depletion of natural resources beyond threshold values can affect the ecosystem capacity and its ability to replenish renewable resources. IO modelling can be used to assess how marine industries impact upon one another and interact with natural resources, by linking ecological systems to the economy. IO tables capture the indirect effects of economic activity but feedback loops between ecological systems and the economy must also be incorporated to capture the net impact of activities within the marine environment.

This study applies ecologically-extended IO techniques to enable application beyond fisheries to other important marine industries such as offshore wind energy. A Leontief demand-driven IO model is presented here that evaluates the sustainable harvest of resources from the ecological system by applying a limit to demand. Cross-sectoral and self-affecting ecological feedback loops are considered to reflect complex interactions between the economy and the natural environment. An adaptation of the Ghosh supply-sided inoperability model is also extended to the ecological system and its validity is considered in the context of the Blue Economy. Illustrative results are produced using 2013 UK analytical tables with a disaggregated electricity industry and applied to several marine sectors. This approach can be used to assess different scenarios for growth strategies in the marine environment, evaluating trade-offs between value-added and the health of ecological stocks. It can also provide an important link between IO modelling and natural capital satellite accounts in EU member states.

## **Uncertainty implications of hybridization in life cycle assessment**

Topic: Life-cycle analysis

Author: Sangwon SUH

Co-Authors: Jessica Perkins

Hybrid Life Cycle Assessment (LCA) uses both process-level and sector-level input-output data in a mixed-unit setting. While it was argued that iterative hybrid LCA technique efficiently reduces the uncertainty in an LCA results, empirical analyses to support the argument have been sparse. We selected an existing process LCA on jacket manufacturing, and applied the hybrid technique. Using Monte Carlo Simulation, we analyzed the effect of hybridization, performed one flow at a time, on the shape and position of the distribution in the results. The results show that hybridization effectively moves the mean and the median of the result higher, while generally maintaining the breadth of the distribution. Analyzing the contribution of each input to the overall distribution of the results, we found that the major uncertainty contributors are not necessarily from the input-output side; both process and input-output side of inputs were identified as the major contributors to the overall uncertainty of the results. We simulated the potential effect of collecting higher quality data for those key uncertainty contributors. The simulation results show that the breadth of the distribution can be narrowed efficiently by targeting the top uncertainty

contributors for additional data collection and refinement. Our results suggest that iterative hybrid has the potential to improve both precision and accuracy of the results in a cost-effective manner.

## **Implications of China's accession to the World Trade Organization on global carbon emissions: a historical perspective**

Topic: GVC Environment-Economy

Author: Sangwon SUH

Co-Authors: Rutger HOEKSTRA, Bernhard MICHEL

A recent study suggests that international sourcing contributed to an increase in global carbon dioxide emissions due largely to the carbon intensity disparity among high and low wage countries. The role that China's accession to the World Trade Organization (WTO) in 2001 played in shaping the structure of global carbon emission transfer through sourcing has not been fully understood. Here we grouped the global economies into five, namely the U.S., China, European Union (EU27), other OECD countries, and the rest of the world, and decomposed the changes in the global carbon emissions from 1995 to 2001, and from 2001 to 2007. The results show that the structures of global carbon emissions through sourcing between the two periods are strikingly different. Global carbon emission transfers to China through international sourcing was less than 200 million tonnes until 2001, and other low-wage countries dominated the global carbon transfer through sourcing. During this period, international sourcing contributed to a net increase in global carbon emissions by less than 100 million tonnes of CO<sub>2</sub>. During the period from 2001 to 2007, however, China absorbed as much as 1,000 million tonnes of carbon transfer not only from the high-wage countries (U.S., EU27, and the rest of the OECD countries) but also from other low-wage countries. Our results suggest that China's accession to WTO has contributed significantly to the shaping of the structure of global carbon transfer through international sourcing. In the light of the international dialogue on Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) and the Paris Agreement, our study calls for an attention to the carbon intensity disparity among international trade partners.

## **Economic Effects of Climate Change in Pakistan by 2050: Role of Agriculture Trade**

Topic: Land-use change and agriculture

Author: Alishba Tahir

Co-Authors: Muhammad Aamir KHAN

Climate Change is an ever growing issue with a great importance due to wide socio-economic effects. Agriculture is the most climate-sensitive economic sector that is influenced both positively and negatively by climate change. A change in temperature or precipitation could cause a significant change in crops productivity and yields. The global change in climate has already impacted the economy of Pakistan in the form of increasing frequency of floods and droughts, low crop yields, irregular weather patterns, less availability of fresh water and the loss of biodiversity. However, international trade of food products overcome the climate-induced losses in agriculture productivity at a most basic level. It contributes to the mitigations and adaptation measures. Different crop/bio-physical experts have been making efforts to process the impact of climate on crop yields through different crop modelings using input from different global climate models. In this research, the output from Decision Support System for

Agrotechnology Transfer (DSSAT) and The Agricultural Production Systems Simulator (APSIM) crop models is used as a shock in the global computable general equilibrium economic model to evaluate the economic effects of climate change by using different types of comprehensive datasets including GTAP Database 2016 and Pakistan Social Accounting Matrix 2017. This type of integrated model is well suited and tailor-made to evaluate the economic effects of climate change at macro as well as at household level. Pakistan has two crop seasons - Kharif and Rabi- therefore two major crops i.e. Wheat and Rice have been chosen for this analysis. A Baseline scenario, representing business as usual with no change in climate, has been created using projections for GDP, population, factor supplies, and required food production. A counterfactual experiment has been done using the same GDP and population growth as in the baseline but in addition of potential agriculture trade deal shocks and crop yield shocks from biophysical and climate models. A comparison of these two experiments has shown that climate change has some serious economic implications for the agriculture sector in Pakistan by 2050.

## **EXPLORING THE EVOLUTION OF INDIA'S ECONOMIC STRUCTURE: THE CASE OF MANUFACTURING-SERVICES INTER-LINKAGES**

Topic: Feedback Session 2b

Author: CHAITANYA TALREJA

### 1. The research question

The Indian economy has seen a rapid increase of the service sector share in its GDP since the early 1990s or during the post-reforms period. The manufacturing sector share in output stagnated during the same period. There was no commensurate increase in the employment share of the service sector and the manufacturing employment share also remained largely stagnant. Greater scope of technological advancement and rapid productivity increase in sectors like manufacturing and now services have placed these sectors at the centre of discussion on economic development through structural change. Based on the historical experience of industrialised nations, manufacturing sector in particular and some service sub-sectors like Information and Communication Technology have been debated as drivers of economic development. It has been well established that the pattern of structural change witnessed in India, particularly during the post-reforms period has been distinct from the established pattern of structural change experienced by early and newly industrialised economies. With this backdrop this research paper is motivated by some questions that have not been addressed in the literature. They are;

- a) How has the integration of manufacturing and services evolved within India's production structure during the post-reforms period? Has rapid service sector growth during this period accompanied a greater integration within India's production structure?
- b) How do manufacturing and services compare in terms of their output and employment stimulating impact on the Indian economy? What are the implications of manufacturing and services production and demand linkages for the structural change and growth process of the Indian economy?

### 2. The method used

The paper draws theoretical insights from the classic works of Albert O. Hirschman and Nicholas Kaldor which provide theoretical foundation for the analysis in this paper from a structuralist perspective. The research on the evolution manufacturing and services production and demand linkages along the course of economic development across various developed and developing regions in the world has established some well developed patterns around these linkages. This paper makes an attempt to evaluate the Indian experience with the backdrop provided by such observed patterns. The paper uses the methodology of input-output analysis to calculate input

cost shares in total intermediate inputs, backward linkages and analysing the demand distributions of manufacturing and service sectors.

### 3. Data used

The analysis in this paper uses the five available Input Output Transactions Tables (IOTTs) for India during the post 1991 reforms period. These are for the years 1993-94, 1998-99, 2003-04, 2007-08 and 2013-14, covering 2 decades of liberalization in India. The first four have been procured from the Central Statistics Office, Government of India and the last one has been produced by National Council of Applied Economic Research.

### 4. The novelty of the research

This research makes a contribution to the debate on structural change and economic development both in terms of the questions it has raised and its findings. No study has delved into the production and demand linkages of the manufacturing and service sectors using IOTTs, in order to understand structural change in India since the liberalization reforms initiated in 1991. The paper finds that manufacturing sector has been much more integrated within India's production structure both, as an input and as a stimulator of output and employment for other sectors, as compared to services. Service sector in this rapid growth phase saw a larger share of value added being generated in modern producer services like ICT, finance and real estate, which contributed much less to employment. The dependence of manufacturing on these service inputs has not been found to have increased as opposed to the internationally established patterns of such dependence which tends to increase over the course of economic development. The role of final demand as a source of service sector demand was much more than intermediate demand. Within final demand private consumption has been the major source of service sector demand. At the same time service sector share in India's private consumption has risen steeply over this period, and was much higher than that of manufacturing. This finding is also incompatible with India's stage of economic development when compared to international experiences. The analysis suggests the existence of a crucial link between the evolution of the production structure and demand pattern in India, which needs to be taken up for further research to elucidate the causal channels associated with this link.

## **Life-Cycle Cost of Manufactured Goods: A Case Study in US Ground Passenger Transportation**

Topic: Life-cycle analysis

Author: Douglas S Thomas

National governments invest in research and development to advance efficiency and spur economic growth. There are, however, few studies that identify where investments will have the largest possible return on investment. This lack of research can result in the funding of investments with suboptimal returns. Initial research in this area has focused on examining production costs; however, to identify high-return areas of research, efforts need to be taken further to include both the production and use of a product. This paper examines the life-cycle cost of passenger ground transportation as a proof of concept to identify those items that have both a high cost and high environmental impact. Public research that focuses on these items has the potential to be more economical than other areas. This paper uses US input-output data from the US Bureau of Economic Analysis, data from the American Time Use Survey, and environmentally extended input-output data to examine the supply chain for production and use of ground transportation equipment. This paper is unique in that it identifies the costs, some of which are not documented in GDP (i.e., uncompensated time use), along with the environmental impacts of producing and using a class of manufactured goods. The Pareto principle, which posits that roughly 80 % of a problem is due to 20 % of the causes, is utilized for targeting specific

efficiency solutions. Those supply chain entities that are above the 80th percentile for both financial costs and environmental impacts are identified. The robustness of this identification is examined using Monte Carlo techniques. Forty-three supply chain entities were identified as being above the 80th percentile for cost, measured in value added, and environmental impact with six being above the 95th percentile for both.

## **Does Global Value Chain Participation Cause Industrial Upgrading?**

Topic: GVC upgrading

Author: Kailan TIAN

Co-Authors: Erik DIETZENBACHER

Participating in global value chains (GVCs) has become a central topic in trade and development policy since it has opened a new way to achieve industrial upgrading. However, some theoretical models suggest that not all countries can upgrade by participating in GVCs and there is little empirical evidence for the effects of GVC participation on industrial upgrading. This paper aims at filling this gap. We use panel data sets covering 40 countries, 34 industries, and 15 years (1995-2009). We examine the effects of two different types of GVC participation (namely backward and forward) on three dimensions of industrial upgrading (productivity, chain, and skill intensity upgrading). Each type of participation is further split into shallow and deep GVC participation. In addition, we examine whether the effects are dependent on the stage of development. We do this by splitting the set of 40 countries into two categories on the basis of their per capita GDPs. The study finds that GVC integration improves the performance in all three dimensions of upgrading (i.e. productivity, chain, and skill intensity upgrading). The results highlight the importance of policy to achieve industrial upgrading through GVC participation.

## **Tourism and Sustainable Regional Development: Measuring the Leakages of Accommodation Industry in Japan**

Topic: Satellite accounts

Author: Oscar Tiku

Co-Authors: Tetsuo Shimizu

Tourism has become an important motor for economic growth creation and regional development. It is perceived as an essential contributor to sustainable development. However, tourism can be a double-edged sword, and if planned and managed non-sustainably it may stunt the regional development especially the community, and ultimately generate long-term negative impact on the host destination.

Tourism leakages have become an arising concern in many tourist destinations and regions all over the world. It dwindles the expected economic advantage and may pull sustainable development out of the region. Three most common types of leakages in tourism that has been widely known are capital transfer to abroad (headquarter), import of goods and services, and remittance from labor (expatriate) in each specific industry. The main question is going to be, how magnificent is the leakage of accommodation industry in Japan. Furthermore, by primarily utilizing Japan Input-Output Table 2011, this study intends to assess the sustainability of accommodation industry in Japan by measuring its total economic impact altogether with the leakages computation primarily in macroeconomic perspective. Specifically, Social Accounting Matrix (SAM) analysis will be employed to address two major parts. Firstly, to measure the total



economic impact of accommodation industry includes its indirect impact on certain income classes. And secondly to calculate potential leakages from accommodation industry in Japan considering aforementioned three type of leakages. Moreover, this study will be the first attempt to measure leakages from a tourism-driven accommodation industry in Japan by using SAM method.

Keywords: leakages, social accounting matrix, accommodation industry

## **Food, feed and fuel: Assessing and comparing global environmental impacts of different vegetable oils**

Topic: Land-use change and agriculture

Author: Johannes TÖBBEN

Co-Authors: Kirsten S. WIEBE, Francesca Verones, Daniel Moran, Richard WOOD

Globally, vegetable oil and especially palm oil consumption has tremendously increased over the past decades due to their high versatility. Apart from being an input for food and feed, cosmetics and other consumer goods, vegetable oils, and especially palm oil, are frequently used as used as a renewable energy carrier [1]. Major energy scenarios expect a further surge of energetic biomass use [2]. While many countries put climate policies into place that promote substituting fossil fuels with low-carbon bioenergy, adverse environmental impacts especially due to land-use and land-use change have raised growing concerns [3]. Since a large share of global vegetable oil production is traded internationally, energy and/or environmental policies, changes in technology and consumption pattern can cause negative environmental impacts virtually everywhere in the world.

We quantify environmental impacts of vegetable oil consumption using a hybrid version of multiregional input-output model EXIOBASE for tracing the direct and indirect effects of the changes through the global production network. In this database, the aggregate agriculture and food sectors are replaced with highly detailed FAO data on the production, trade and consumption of the most important oil crops and vegetable oils in physical units. The integration of these data is carried out using a maximum entropy approach, which allows for the simultaneous estimation of unobserved commodity flows, as well as corresponding prices. Thus, possibly conflicting data constraints in various units of measurement, levels of aggregation and mismatching classifications are simultaneously satisfied.

For the results, we analyze the trade-offs and synergies between different environmental impacts, in particular land-use, land-use change, and related biodiversity losses, as well as GHG emissions by country/world region. By looking at both, the consumption and production side, we can identify spillovers of technological change, intermediate and final consumption on the major supplying countries of oil crops. The results show a shift of the environmental pressures across countries and differences in the total environmental pressures, depending on the oil used.

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## **The route of the labor compensation share of the GDP: a structural decomposition analysis for Brazil in 2000-2005**

Topic: Feedback Session 4b

Author: Marcelo Resende Tonon

Co-Authors: Esther Dweck

The aim of this paper is to contribute to the underexplored field of the functional income distribution through a structural decomposition analysis of the main determinants for the behavior of the labor compensation share of the Brazilian GDP. On that scope, it uses the input-output and labor data gathered by the Brazilian Institute of Geography and Statistics (IBGE). The labor compensation in this work is regarded as the wages added by the half of the Gross Mixed Income, since the later may refer to both capital and labor income, considering that the former cannot be distinguished from the latter. The main objective in this paper is to discern the relative empirical relevance of changes in the labor compensation and in productivity, both commons to almost every industry in the economy (shift effects), from the changes in the labor inputs coefficients, in the intermediate input and in the final demands, which in turn are all related to the structural changes (share effects). The dataset used in this work covers the period 2000-2005 and 110 industries of the Brazilian economy. The methodology used is the Structural Decomposition analysis (SDA) proposed by Dietzenbacher et. al (2005), using the Brazilian input-output tables (IBGE, 2008).

## **Long-Run Effects of the Rail Freight Sector Tariff Review Policy in Minas Gerais State, Brazil**

Topic: CGE & Transport

Author: Vinicius A. VALE

Co-Authors: Admir Antonio Betarelli Junior, Weslem Rodrigues Faria, Fernando Salgueiro Perobelli, Suzana Quinet de Andrade Bastos

This study has as main objective to analyze the effects of the recent rail freight sector tariff review policy in Minas Gerais State (Brazil). This policy may affect the sectors related with soybeans, mining, steel, and construction since these activities are the largest demanders of rail transportation service in Minas Gerais State as well as in other Brazilian regions. Regions with more diversified and integrated productive structure, and with significant participation in those sectors intensive in the rail transportation can be the most benefited by the new tariff policy. On one hand, by consequence, the competitiveness of some Brazilian regions can be reinforced, which may bring implications for regional inequality in the country. On the other hand, by complementarity, such policy can lead to a reallocation of some productive activities across the regions.

In order to analyze these effects, we have calibrated a dynamic inter-regional computable general equilibrium (CGE) model for 2010 which recognizes the 12 mesoregions of Minas Gerais State and 26 Brazilian states. The dynamic CGE model has been used to project the long-run effects. The main results indicate that the Brazilian economy would grow with the tariff review policy. The more traditional and exporting regions in production of iron ore, soybeans, corn, and food and beverages were the most benefited regions while the rail sector, in general, has presented some losses. In this sense, our results may contribute to the ongoing debate related with the second cycle of tariff review, planned for 2018 by the ANTT. Furthermore, the results may contribute to the ongoing debate on the Brazilian trade since they pointed out the effects in

terms of foreign sales and, consequently, in terms of the Brazilian's insertion in international trade.

## **Methodology for the estimation of interregional trade coefficients from the approach of the supply and use tables: a multiregional approach at the subnational level.**

Topic: Regional trade

Author: Cristina VAZQUEZ

Co-Authors: Normand Asuad Sanen

The construction of regional input-output matrices is required in Mexico for the diagnosis and territorial analysis that contributes to the understanding of spatially differentiated economic phenomenon and with it, to design policies in order to reduce inequality.

In the construction of regional input-output matrices based on the supply and use tables, the methodology used to identify trade flows between regions is a crucial and complex stage, since it constitutes the estimation of economic interactions between regions. This specific phase is barely treated in the regional product input literature from a perspective that recognize regional attributes.

The objective of this article is to present a methodological proposal for the estimation of inter-regional trade coefficients. For this, the approach of the supply and use tables will be used, which together with hybrid methods will estimate the commercial flows between the economic activities across regions, starting with the identification of productive chains by means of principal components, to later estimate trade coefficients from a multiregional interaction index at the subnational level. The research question is: What is the ideal procedure for the estimation of commercial coefficients based on hybrid methods, in order to recognize the economic interaction between regions within the framework of a multiregional model at the subnational level?

The formalized methodological proposal will be presented for the northern central region of Mexico for 2008, using the information on the 2008 input-output matrix and economic censuses. The paper is organized into four general sections in addition to the problem statement: 1. Literature Review , 2. Methodological proposal and 3. Multiregional subnational application, and 4. Conclusions

The novelty of the work consists in the approach used from the spatial dimension of the economy to estimate inter-regional trade coefficients based on regional economic interaction index.

## **Impacts of a Reduction in Water Availability for Agriculture in Brazil**

Topic: CGE & Agriculture and food

Author: Jorge Henrique Norões Viana

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This paper develops a CGE model to assess the economic impacts of possible reductions in water availability on agriculture. To build the model various methodological tools were required.

Translog production functions for the agricultural sector and the Water & Sewer sector (WS) were all estimated based on the 2006 Agricultural Census and the National Sanitation Information System (NSIS) respectively. The CGE model was calibrated using 2009 national input-output data and incorporating the estimated demand system and production functions parameters previously estimated. We simulated three scenarios involving exogenously restrictions of water availability for agricultural sectors of 10%, 20% and 30% thus yielding endogenous tariffs or willingness to pay (WTP) for water use in each of the agricultural sectors. The revenues of these rates remained under government domain in these three standard scenarios. In addition, two other scenarios were simulated with water restriction of 30%, but with the revenues from these tariffs passed on directly to the families or used to subsidy the WS sector. Among the various results, the reduction in the total demand for raw water (blue water) was greater than the reduction in agriculture production, with the primer reaching 18,44% under a water restriction of 30%. As for total production, the greater reduction was 0.39% under a water restriction of 30%. About the tariffs on water use obtained endogenously, they were much higher than those currently practiced in some regions in Brazil. Conversely to what is presented here, the model can simulate various exogenously raw water tariffs for the two sectors (agricultural and WS) and measure the resulting economic impacts. To the best of our knowledge, this is the first CGE model developed for Brazil that both actually incorporate endogenous demand for water in agriculture production and does so by using econometric estimates of the parameters of that demand.

## **The use of water and the interdependence of regional economies: the case of Brazilian Hydrographic Basins**

Topic: Sustainable production and consumption

Author: Jaqueline Coelho Visentin

Co-Authors: Joaquim J.M. GUILHOTO

Brazil is known for its satisfactory water availability. However, there is an uneven spatial distribution of this resource in the country. These characteristics, combined with the strong economic concentration, have caused some regions to face scenarios of water restrictions. In this work, the objective is to identify the main water users in Brazil. To achieve this goal, it were calculated the direct technical coefficients of withdrawn, consumption and return of water, volume of water use, the Virtual Water interregional flows and the Water Footprints of the Hydrographic Basins of the National Water Resource Plan. Based on this information, the impacts of the current water use pattern on the local Water Balance were verified. In order to meet the proposed objectives, an interregional input-output system with 50 sectors and 56 regions for 2009 was estimated. Among the main results, it is worth noting that the Hydrographic Basin Litoral AL PE PB was the main responsible for water withdrawn in the country, while it presented the worst Water Balance. In addition, it was verified that the Tietê Basin was the main region from the water demand point of view. Regarding the interregional flows among the Watersheds, it were verified that the water interdependence was bigger than economic interdependence and that 66% of exported Virtual Water volume among the regions came from Basins where the Water Balance was critical. From this information, it was found that these exports affected the water availability of some Basins with an unsustainable Water Balance. Thus, it can be concluded that in some Hydrographic Basins the exports of Virtual Water counteract what is expected from the water security point of view. Front of that, public policies are required to promote the use of scarce water resources in a less intensive way in these regions.

## **An Alternative Approach for Estimating Imports Uses and Industry of Destination - The Case of Israel**

Topic: Feedback Session 5b

Author: David Wajnryt

Co-Authors: Helen Brusilovsky

One of the main challenges in economic statistics today is the classification of imports by use and industries-of-destination. Such classification provides an important analytical economic framework, and is one of the main components in the compilation of Supply, Use and Input-Output tables.

The main approach presented in the literature is based on differentiating between direct and indirect imports. For direct imports, the total value of imports for each industry is calculated using business surveys and then allocated to commodity groups through a general distribution based on imports data by commodity. The uses of indirect imports are allocated using broad assumptions such as the proportionality assumption.

In this paper, an alternative approach is proposed, based on the creation of a classification table of uses and industries-of-destination by commodity and importer. This table facilitates the compilation of statistics that take into account the weight of each commodity and importer at any given period.

In this approach, the uses of imports for selected commodities are assessed using administrative data. For the remaining commodities, imports are identified as direct or indirect based on the importer's industry in the business register. Importers classified as wholesale or retail trade in the business register are considered indirect while the remaining importers are considered direct. A complementary survey of selected importers is used to identify those that import commodities for both direct use and resale.

The uses of direct imports are defined according to the commodity description, and the industry-of-destination is assessed using the business register. Indirect imports uses and industries-of-destination are assessed via survey.

The case of Israel is presented, including examples of the use of administrative data and practical guidelines on how to maintain and update the classification table. Survey methodology is described, including population, questionnaire, quality management, integration and analysis.

## **Income-based emissions of Jing-Jin-Ji megaregion at city level**

Topic: China's Interregional Input-Output Database: Construction and Applications

Author: Yafei WANG

Co-Authors: Lixiao Xu

This paper uses the multi-regional input-output (MRIO) framework at city level to carry out the Jing-Jin-Ji income-based emissions for the year 2013. The work encompasses a range of advances that reach beyond the previous studies.

(1) Calculate income-based emission at the city level. This can find the relationship between emissions mitigation and economic growth at city and sectoral level and guide new policies at industrial level from the income-based perspective; (2) Build a nested subnational MRIO table with cities and provinces in China, including 14 cities of Jing-Jin-Ji megaregion and 28 provinces of the rest of China; (3) Chose a meaningful latest year for 2013 when China central government was concerning about Jing-Jin-Ji Coordinated Development strategies.

The results show the distribution of emissions enabled by primary input (income): (1) Higher production-based emissions always accompany higher income-based emissions. (2) Ten in fourteen cities have more than half of income-based emissions occur at domestic, except Beijing, Xingtai, Baoding and Langfang. (3) The main emitters of 14 cities of income-based emissions are developed provinces (such as Jiangsu, Guangdong, Shandong and Zhejiang) and resourceful provinces (including Inner Mongolia, Shanxi, Liaoning and Xinjia

## **A critical review of the global MRIO databases**

Topic: Global databases

Author: Kirsten S. WIEBE

Co-Authors: Anne OWEN, Moana SIMAS

The analysis of global production networks is inevitable in an increasingly globalized world. Several global multi-regional input-output (MRIO) or global inter-country input-output (ICIO) databases have been developed. These databases link production across industries and countries with consumption and are therefore able to give a near complete picture of the global economy and its interdependencies. In addition, for most of the databases a variety of environmental and socio-economic extensions exist, that are linked to industrial production. This allows for an analysis of the interactions between economic activities and environmental and socio-economic pressures. These databases are based on more or less the same data, but use slightly different approaches for constructing the global table, as well as different industry/product and country resolutions. This results in significant differences in some of the indicators calculated with the different databases. Substantial work has been done to compare the databases, but consolidated information for database users is still missing. This paper aims at clarifying which database can be used for what type of analysis and assesses the associated uncertainties. Each database has some advantages over the other databases, but also some shortcomings. It is therefore vital to sufficiently inform the database users, for them to be able to correctly interpret and contextualize the results.

## **How the global demand linkage was changed after the world finance crisis?**

Topic: Feedback Session 3a

Author: Kaiyao Wu

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(1) the research question.

In recent years, economic globalization shows signs of retrogression. We argue that the signs can be backdated to the world finance crisis. In this article, we will take a detail portrait on the evolution of global economic interaction and verify our argument. Our focus will be demand linkage among sectors in major countries, from a perspective of global economy.

(2) the method used.

Based on multiple regional input output (MRIO) model, matrixes of demand linkage among the major countries for every years are constructed.

Demand linkages among the major countries are divided into 3 part: intra-regional multiplier effect, inter-regional spillover effect, inter-regional feedback effect, using the decomposing model, which was initiated by Miller(1963), and further extended and applied by Round(1985,2001), Dietzenbacher(2002), Pan(2015), Zhang(2017),etc.

Linkage networks are analyzed with social network analysis (SNA). Network visualization, triad census and cohesion metrics will be applied.

(3) the data used.

Which is from updated World Input-Output Database (WIOD), newly released in 2016, providing an annual time-series of WIOTs from 2000 to 2014. It covers forty-three countries, including all twenty-eight members of the European Union and fifteen other major economies.

(4) the novelty of the research.

Applying MRIO-based intersectoral demand linkage networks to mimic the global economic systems involving regional and world trade. Not only metrics measuring regional demand linkage are derived and analyzed with MRIO models, but also metrics measuring the network are derived and analyzed with SNA. So we can take a more systemic and explicit picture on the evolution of global economic interaction.

## **Study on import price transmission with time lag based on non-competitive input-output model**

Topic: Feedback Session 4a

Author: Ran Xu

**Abstract:** With the deepening of China's integration into the global value chain, the transmission of price fluctuation of imported products has become an important part of the industrial economic research, while traditional research methods cannot reflect the time lag in price transmission. This paper established a non-competitive input-output price model and measured the biggest potential impact of price changes of imported products on the prices of various departments in China based on the Chinese input-output table of 2012. Furthermore, by introducing the factor of production time lag, this paper gave the discrete state iterative equation of import price transmission. Results show that the import prices of mining and electrical and electronic departments have the highest influence on the domestic market, and the degree of influence is distributed on the timeline. Also, some policy suggestions were discussed accordingly.

**Keywords:** price transmission, non-competitive input-output model, time lag

## **OECD Inter-Country Input-Output Database 2018 edition**

Topic: Value Added in Trade and the OECD ICIO

Author: Norihiko YAMANO

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Over the past five years, OECD's Inter-Country Input-Output (ICIO) database has established itself as an important source of information for academic research and policy analyses, contributing to new insights into the impacts of economic globalisation. However, when constructing and updating an ICIO, many practical and methodological hurdles need to be overcome in order to obtain a consistent dataset. This paper presents the main characteristics of the latest edition of OECD's ICIO (2018) and summarises the challenges faced, and the solutions applied, during its development. The new edition of ICIO is based on national statistics compiled according to the 2008 System of National Accounts (SNA08) framework with an ISIC Rev.4 industry classification. Notable features include i) wide coverage of the global economy (more than 60 economies); ii) tables covering all years 2005 to 2015; iii) benchmarking to latest official annual National Accounts statistics; iv) distinction between cross-border trade and direct purchases by non-residents; and, v) extensions to account for firm heterogeneity in China and Mexico -

notably, to distinguish processing trade sectors. The OECD ICIO is a main source of Trade in Value Added (TiVA) indicators and other metrics related to GVCs such as employment embodied in trade and estimates of carbon footprints.

## **Lifestyle changes and enhancing energy efficiency in China to contribute to global emission reductions**

Topic: Sustainable production and consumption

Author: Bingqian YAN

Co-Authors: Erik DIETZENBACHER, Bart LOS

According to UN Environment Program (UNEP), a reduction of 12-14 Gt CO<sub>2</sub> emissions before 2030 is necessary to achieve the goal of limiting temperature rise below 2°C. As the largest carbon emitter, China plays a key role in fulfilling the global emission reduction target. On the one hand, this requires establishing energy policies to reduce emissions in the production processes. On the other hand, also consumers are expected to contribute by changing their consumption patterns towards products that are produced less emission intensive. This is because (as previous studies have showed) the emission growth due to increasing final demands has out-paced over time the emission reduction due to energy efficiency enhancement. With a high speed of economic growth and improved living standards, China faces a high pressure in particular on reducing emissions through changing final demands. This brings us to the question how lifestyle changes by Chinese households (by following the European consumption pattern rather than the predicted way of living) can contribute to global emission reductions by 2030.

This paper evaluates the emission reduction effects from both the consumer and the producer side. We examine the effects of lifestyle changes and changes in the mix of energy inputs. To this end, we develop an environmentally extended multi-regional input-output model to project emissions until 2030 under different scenarios. The characteristic features of the model are as follows. (1) GDP level in each country during the projection period is endogenously determined by the model, based on input-output analysis. (2) Final demands are estimated on the basis of previous year's GDP. (3) The composition of household consumption by product in each country is obtained from applying the Almost Ideal Demand System (AIDS). (4) The policy effects and ongoing trends in the global market are reflected by making Chinese final demand and intermediate inputs more dependent on domestic suppliers and less on foreign suppliers. (5) The emission coefficients in each industry are based on energy inputs. The structure (or mix) of energy inputs particularly in China follows and extrapolates historical trends.

We apply input-output analysis annually and use this year's projected output to determine next year's final demands. We thus arrive at the emission level in 2030 for the baseline scenario. In the low-carbon lifestyle scenario, we assume that the Chinese household consumption pattern follows the historical pattern of a European country that had the same GDP per capita level in the past as China in 2014. In the accelerated energy efficiency enhancement scenario, the annual decreasing rate of coal use in each industry is assumed to be 1.5 times as in the baseline scenario.



## **Quantifying regionalised embodied carbon emissions of buildings using an integrated hybrid life cycle inventory model of Australia**

Topic: Life-cycle analysis

Author: Man Yu

Co-Authors: Thomas O. WIEDMANN

Although hybrid life cycle assessment (hLCA) is developed with the intention to harness the merits of both process-based LCA and environmentally-extended input-output analysis (EEIOA) to enable a specific as well as complete LCA, it has not been routinely employed to quantify embodied carbon emissions due to limitations remaining around data availability and uncertainty. This study intends to alleviate these limitations by developing, verifying and applying a hybridised life cycle inventory database in an Input-Output Virtual Laboratory (IO-VL).

The Australian Industrial Ecology Virtual Laboratory (Australian IELab) is one of the IO-VLs, which compiles the most comprehensive Australian multi-regional input-output databases based on a high-performance computing infrastructure. By merging Australian IELab with the Australian National Life Cycle Inventory database (AusLCI) in an integrated way, a virtual lab hLCA framework is established and applied to deliver a fully hybridised and regionalised LCI database covering all 4463 AusLCI processes with quantitative uncertainty information included.

With this newly developed hybridised LCI database, a streamlined hybrid analysis will be conducted to quantify the embodied carbon emissions of typical Australian buildings in different regions to demonstrate whether the accuracy of results will be significantly influenced by geographical and technological representativeness within the national boundary. These hybridised results will also be compared with the results generated out of pure process-based analysis to illustrate the comprehensiveness of hybrid LCA.

Keywords: integrated hybrid life cycle assessment, input-output virtual laboratory, embodied carbon emissions, buildings, Australia

## **The methodology research of constructing APECIOTs**

Topic: Implications of GVCs

Author: Jianqin YUAN

Co-Authors: Norihiko YAMANO, Yaxiong ZHANG

This article describes the methodology and procedures on how to build APECIOTs based on supply and use tables. Supply and use tables are increasingly important for national accounts and the regional TiVA database. However, at present, supply and use tables are not available for most APEC economies, so, the main challenge and advantage of the construction is getting the official original national basic data, estimating the supply and use tables at basic price for most APEC economies and compiling the APECSUTs with 51 products and 34 industries in 2005 and 2012. The APECIOTs are available for the 2005 and 2012 and give the values of transactions among 34 industries in 21 economies plus the rest of the world and from these industries to households, governments and users of capital goods in the same set of economies. The article describes how information from the National Accounts, Supply and Use Tables and International Trade Statistics have been harmonized, reconciled and used for estimation procedures to arrive at a consistent APECIOTs.

## **Chiapas Economic Structure: a Qualitative Input Output Analysis with a spatial approach**

Topic: Regional & spatial

Author: Krista Zafra

Co-Authors: Normand E ASUAD, Julián Equihua, Esther Quiñones Luna

The structural analysis of an input-output system may have a qualitative and a quantitative dimension (Ghosh & Roy, 1998). There has been an important development of tools to study quantitatively the structure of the interindustry relationships. However, there has been a neglect of qualitative aspects of the input-output structure. For instance, the relevance of a sector in the transmission of influences between others sectors. (Cárdenas, Brugués, & Fuentes, 2013). It may happen that the position of a sector in a network of economic activities is more relevant than its size.

Furthermore, either the quantitative or the qualitative structural analysis of the input-output system cannot tell us anything from the spatial location of the important features identified by these analyses.

From this perspective, the present paper conducts a qualitative and spatial input-output analysis of Chiapas's state (Mexico) economic structure for the year 2008. The objective of the research is to identify 1) the most important industries for a qualitative approach and 2) their location in the micro regions of Chiapas.

To achieve this, a Multiregional Input-Output Matrix of Chiapas' state is constructed mainly with data from various official sources for 2008, under a hybrid approach to construct state economic accounts. Based on this multiregional matrix, a qualitative matrix is then constructed to identify the most important sectors located in their micro regions.

This research has two novelties. On one hand, the construction of the Multiregional Input Output Matrix with a hybrid approach, which consists in the develop of a regional database adjusted with balancing and calibration processes through the accounting identities. This approach beholds the spatial perspective itself, relevant to understand the specificities of the micro regional performance of the state. On the other hand, the identification of important sectors based on a qualitative input-output analysis provides important insights in the interindustry structure of Chiapas' state.

Key words: Qualitative Input Output Analysis, Spatial Approach of the Economy, Regional Database

## **The Short-term Effects of Carbon Taxation in China: An Analysis Based on Energy Input-Output Model in Hybrid Units**

Topic: Energy and emissions

Author: Hongxia ZHANG

Co-Authors: Geoffrey J.D. HEWINGS

The aim of this paper is to evaluate the effects of Carbon Taxation in China, including the distributional effects on different household groups based on income levels, the effects on economic growth and emissions reductions. For this purpose, we build a price model based on an energy input-output table in hybrid units. The advantage of the energy IO model in hybrid units is that it satisfies energy conservation conditions easily, which ensures the consistency of the energy total requirements flows. The databases used for our simulation include the 2012 Chinese

input-output table, the energy consumption data by industries, the Household Sample Survey, and China Residential Energy Consumption Survey (CRECS 2012). The main results indicate that, in short-term, a carbon tax has a relatively small negative impact on GDP. There are, however, relatively significant emissions reductions. The results of the distributional effects show that, for urban residents, the impacts of carbon taxation on different household groups have a relatively small differences, and are slightly regressive. Yet for rural residents, a carbon tax may be significantly regressive, and it also reveals that rural residents are affected much more than urban residents. As further analysis, by constructing quadratic programming models, we investigate the effects of redistributing the carbon tax paid by households in order to offset the negative distributional effects of carbon taxation. The results reveal that if the amount of carbon tax directly paid by households is given to the groups with low income levels, the regressivity of carbon tax will be removed largely. If the total carbon tax directly and indirectly loaded by households is reallocated to the groups with low income levels, the situation of inequality will be improved. Then, using Miyazawa's input-output model, we compute interrelational income multipliers. The results indicate that the household groups with high income levels would benefit largely from the income increases in household groups with low income levels, which means that compensation to groups with low income is a superior choice for redistribution of carbon tax.

## **Difference in regional productivity and unbalance in regional growth**

Topic: Multiplier & Linkages Regional

Author: Jie Zhang

Co-Authors: Nino Javakhishvili-Larsen

Aim of this paper is to investigate the relationship between the changes in productivity and economic growth in Danish regions at the NUTS 3 level. Using the historical data we compare the changes in the sector productivity before and after the financial crisis in 2008-2009. It shows that there is a difference in the sector productivity among the regions, i.e., the productivity in the new and creative economic sectors in the urban regions is increased, but the traditional sectors such as agriculture and some of the industrial sectors have decreased. After analysing the changes in the sector productivity from 2000 to 2016, we set up the baseline forecast for 2020 in SAM-K and LINE model with two conditions - baseline 1, describing macroeconomic conditions with constant sector productivity coefficient and baseline 2, describing the macroeconomic conditions with the sector productivity trend since 2000. By observing the differences in the baselines we identify and select those two sectors (a and b) that have experienced strongest positive (sector a) and negative (sector b) changes in the productivity. We investigate the regional distribution of these two sectors in Denmark in order to set up the scenario analyses to identify how the changing trends in productivity within the selected sectors have direct and spill-over effects on the regional growth.

Second part of the paper focuses on the scenario analysis. Scenario experiments are developed based on the baseline 1 and includes two assumption to observe the regional growth of the NUTS 3 regions in Denmark. In scenario 1 we assume that the productivity in the selected sector b (with negative productivity change) will increase by 10% in 2020. Analysing this scenario we can observe how much productivity gain in the given sector will contribute to the regional GDP and net-commuting in the urban and rural types of regions. In the scenario 2 we assume that the productivity in the selected sector a (with positive productivity change) will decrease by 10% in 2020. By analysing this scenario we can observe how much productivity loss in the given sector will effect the regional GDP and net-commuting in the urban and rural types of regions in Denmark.

Paper will present the results of the IO and CGE (SAM-K and LINE) modelling for the baselines, with and without the productivity trend, and the two scenario analysis, with increasing and decreasing productivity assumptions. We expect the results to explain the GDP growth and potential changes in the labour market in the Danish NUTS 3 regions that are aggregated based on the urban-rural typology. In addition we also expect the conclusions to detect some policy implications for the lagging and peripheral regions in the ongoing economic changes in Denmark.

## **Exploring Drivers of Beijing's CO2 Emissions Increment: A comprehensive multi-level factor analysis**

Topic: Regional energy & environment

Author: Junrong Zhang

To explore the determinants of energy related carbon emission increment in Beijing, Logarithmic Mean Divisia Index (LMDI) decomposition method based on the input-output model is applied, and a comprehensive analysis from overall & sectoral perspective with multi-level factor decomposition is provided. First, carbon emission drivers are decomposed into three first-level overall factors from general perspective, i.e., emissions coefficient (e), production structure (L), and final demand (Y). Second, decompose the drivers into eight second-level specific factors, to reveal the detailed driving mechanism. Based on the latest physical-monetary input-output table of Beijing, some interesting findings can be obtained via the empirical study. (1) The trajectory of CO2 emissions in Beijing appeared an unstable trend from 1997 to 2012, which is associated with the extent of its coal consumption. (2) As for the first-level overall factors, emissions coefficient (e) is observed as the leading driver of Beijing's carbon emission mitigation, while final demand usually pull the emissions significantly. Specifically, production structure has become a strong factor to offset carbon emissions from 2007, which emerges an opposite effect during 1997-2007; As for the second-level specific factors, the final demands distribution (D) is consistently tested to be a key driver of Beijing's carbon reduction. (3) Regarding to the sectoral perspective, the sector of smelting and pressing of metals (S14) contributes to the emissions decline effectively, while the sector of production and supply of electric and heat power (S4) and the transportation sector (S19) promote the increase of emissions obviously. This study shed light on policy makers to choose the scientific and effective industrial structure adjustment strategies and provide some other policies which can conduce to Beijing's emission mitigation.

## **Multi-Layer Construction Framework for Sub-region Input-Output Table**

Topic: Feedback Session 5b

Author: HERAN ZHENG

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Multi-region input-output (MRIO) models have become increasingly important in economic and environmental analysis. Although many studies have constructed MRIO models at various scales, the current resolution of most MRIO models fails to capture the heterogeneity between sub-regions, especially in cities. Given that city-level policymaking plays a crucial role in regional development strategies, the lack of high-resolution city-level MRIOs 1) undermines the understanding of the disparities between cities within a single region or across regions, especially for large geographical regions, and 2) fails to comprehensively capture the linkages between trade partners in cities (including at the provincial or national level) and identify the role of cities

role in supply chains at multiple scales. Detailed information at the city level could be much more meaningful to local governmental decision making than general information from interregional or international MRIOs. The lack of city-level MRIO tables has negatively impacted the growing number of city-level studies.

Here, we propose a bottom-up framework for sub-regional level MRIO table compilation based on partial-survey methods. To compile large-scale MRIO tables, a conventional approach using the partial-survey method requires that all regions must be included within certain boundaries, which results in very large workloads. For example, creating the MRIO table in the EORA database involved compiling 187 countries with international trade links; in total, this included  $5 \times 10^6$  data points. For more detailed sub-regions, workloads could be even greater, making data input and processing impractical. To overcome this difficulty, we introduce a multiple-layer compilation framework to decompose the compilation processes into multiple layers; the MRIO table can then be linked at these layers to create a full sub-regional MRIO table. We employ two steps in the multiple-layer framework. In the first step, we begin MRIO table construction at the lowest layer and use the partial-survey method to compile a partial sub-region MRIO table within the larger region. The term “partial” here is relative to the full MRIO table from the perspective of a country. The partial sub-region level MRIO table developed in step 1 would be treated as the elementary matrix in the next step, in which it is reconciled into the higher layers. Secondly, we integrate and link the partial sub-region MRIO tables into the regional MRIO table based on the assumption of an identical trade coefficient. The regional MRIO table is treated as a reconciliation platform to link all the partial sub-region MRIO tables and create the full sub-region MRIO table. In other words, we insert the partial sub-region tables into the regional MRIO table. For example, to theoretically compile a China city-level MRIO table, our approach would first compile the city-level MRIOs within a province (such as compiling MRIO tables for the 11 cities in the province of Hebei), and then insert them into the existing province-level MRIO table with reconciliation to create a nested city-province MRIO table. The resulting nested city-province MRIO table can be used as a platform into which a new partial city-level MRIO table in the province can be inserted. To get the full China city-level MRIO table, the two procedures would be repeated for the other provinces using balancing and reconciliation until all the provinces were replaced by their city MRIO tables.

By applying this framework, we first construct Hebei 11 cities MRIO table and Jing-Jin-Ji urban agglomeration city level MRIO table through bottom-up approaches. The nested Hebei-China MRIO table is also produced in this process, which can be the further platform for other cities. This multiple-layer framework represents a feasible approach for developing sub-regional level MRIO models and offers the possibility to analyse global trade at the sub-regional level.

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