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Changing Patterns of Trade and Global Value Chains in ASEAN-China Free Trade Area

Topic:
Author: imam ABBAS

The China-ASEAN Free Trade Area brought transformative effects on the economic and trade dynamics between China and ASEAN nations. This article aims to examine the mechanisms through free trade zones facilitate the profound integration of these economies into the global value chain. It explores the eradication of trade barriers, augmentation of bilateral trade volumes, diversification of trade structures, and the promotion of dynamic processes within FTA economic integration. By generalizing the WWZ (2013) export accounting framework, we are able to fully decompose the total value added of bilateral trade into domestic value added (DVA) and foreign value added (FVA) exports at the inter-country and sectoral levels of the ACFTA. This provides a comprehensive understanding of the different categories of goods and services that are being traded as well as the different stages of production that are involved within GVCs.We present the disaggregated decomposition results among China and ASEAN countries in selected sectors from 2000 to 2021 based on the ADB MRIO tables and show how they help us better understand the changing patterns of trade and GVCs in the ASEAN-China FTA.The results show China's escalating significance in ASEAN's trade ecosystem, marked by a pronounced export surge, particularly in intermediate and final products. These results underscore China's central role in regional supply chains and its successful ascension within the value chain, evidenced by a notable increase in DVA exports. Such advancements denote China's growing influence and a strategic shift towards higher production stages. Furthermore, the substantial rise in FVA content, alongside the variations in returned value added and double-counted content, captures economic participation and integration's dynamic and multifaceted nature, shedding light on the intricate supply chains and production processes that characterize contemporary GVCs. The ASEAN-China FTA emerges as a catalyst in this context, enhancing economic connectivity and fostering deeper integration. The FTA has promoted economic upgrading and shifting towards more complex manufacturing and service sectors by easing the exchange of goods and services regionally, thereby accelerating ASEAN's incorporation into GVCs. This has fortified economic ties and introduced a heightened level of complexity and evolved interrelations, paving the way for further collaborative growth within the region.

A MR EEIOA-based framework for identifying synergies and trade-offs of circularity interventions

Topic: Special session: Advances in Circular Economy Scenario Modelling
Author: Glenn Alonso AGUILAR-HERNANDEZ

Background
Circular economy (CE) scenarios have contributed to understanding the potential economic, social, and environmental implications of a circularity transition on a country and global scale using macroeconomic models

. Furthermore, some researchers have identified potential trade-offs within circularity interventions

. For example, an increase in recycling activities in Europe could potentially create more sources

of employment in European countries while reducing job creation in middle- and lower-income regions (e.g., in Southeast Asia and Lantin America). Although several CE scenarios point out potential trade-offs and synergies, there is still a lack of understanding about who would be the winners and losers of a circularity transition.
Several frameworks have been developed to identify trade-offs and synergies. For example, the application of multi-criteria, data envelop analysis, and triple-bottom line approaches has facilitated the identification of trade-offs between socio-economic and environmental impacts of multiple interventions. Within this context, Multi-regional environmentally-extended input-output (MR EEIO) analysis has been used as a quantitative tool for exploring potential trade-offs and synergies.

Research Question and Aim
However, to the best of my knowledge, there is no systematic way to identify and assess trade-offs and synergies of the ongoing development on circularity transition between the Global North and South (e.g., between the EU and Latin America), including their potential socioeconomic and environmental impacts. This raises the question: “How can the potential trade-offs and synergies of different CE scenarios be systematically identified to facilitate the interpretation of CE modeling in MR EEIO?”
In this paper, I aim to develop a novel MR EEIO-based framework for identifying trade-offs and synergies of circularity interventions. The framework provides three key dimensions - geographical, impacts, and sectoral - that allow for the identification of ‘win-win’ and ‘win-lose’ situations from a multi-dimensional perspective.

Method and Data
I will review the existing literature on frameworks for trade-offs and synergies analysis, such as cost-benefit, multi-criteria, data envelop, and triple-bottom-line analysis. Then, I will define the key dimensions of trade-offs and synergies within circularity interventions and develop algebraic expression for quantifying each dimension in an MR EEIO system. Finally, I will illustrate the use of the MR EEIO framework with a case study focusing on the potential trade-offs and synergies between the European Union and Latin America if both regions implement circularity interventions simultaneously. For this example, I will use the MR EEIOA implemented by Donati et al. (2020) using EXIOBASE v3 for 2019. I will then apply the proposed framework including the dimensions (i.e., geographical, impact, and sectoral).

Novelty
This is the first MR EEIOA-based framework that allows for the identification and assessment of trade-offs and synergies of multiple circularity interventions in a systematic way. This will contribute to facilitating the interpretation of CE modeling and support decision-making in CE policies, which are in ongoing development worldwide.

Inclusive Prosperity: A Gendered Analysis of Policies Promoting Women's Economic Empowerment

Topic:
Author: Irfan AHMED

Women play an important role in all walks of life because of their active roles in core economic sectors such as agriculture, livestock management, energy, disaster risk reduction (DRR), forestry, water management, and health. Gender integration in all areas of policy choices and at all stages of the decision-making process is an essential consideration of Saudi Arabia's Vision

2030. Nonetheless, figuring out how women can support inclusive economic growth is crucial. This study investigates the impact of women's labor participation on GDP, household consumption, and Investments. Moreover, the study finds disaggregated effects on employment.
The primary data source for this research is the gendered Social Accounting Matrix (SAM) of Saudi Arabia. This matrix categorizes labor and households into male and female classifications, providing a detailed representation of the economic activities involving both genders. The study employs a dynamic Computable General Equilibrium (CGE) model to analyze the impact of women's participation in labor.
The novelty of this research lies in its comprehensive exploration of the impact of women's participation in labor on key economic indicators in the context of Saudi Arabia. By constructing a gendered Social Accounting Matrix and employing a dynamic Computable General Equilibrium model, the study offers a nuanced understanding of how gender integration in labor can influence GDP, household consumption, investments, and employment. This approach contributes to the broader discourse on gender-inclusive policy choices and decision-making processes, aligning with the goals outlined in Saudi Arabia's Vision 2030. The disaggregated analysis of the effects on employment adds further depth to the investigation, providing valuable insights for policymakers and researchers interested in the economic empowerment of women in Saudi Arabia.

Exploring the Emergence of Waste to Energy sector in India through an Input-Output Framework

Topic: Input-Output Analysis
Author: Ananya AJATASATRU
Co-Authors: Kakali MUKHOPADHYAY

Effective waste management is a pressing global concern, and in the context of a rapidly growing nation like India, it poses unique challenges and opportunities. This paper explores the application of Input-Output (IO) framework as a strategic tool for optimizing waste management practices in the Indian context. A transitioning economy such as India which is undergoing demographic growth paired with rapid urbanization and industrialization generates 62 million tons (MT) of waste annually; of which 70 percent is collected and only about 17 percent is treated while rest are dumped in landfill sites. The IO framework, traditionally employed in economic analyses, is adapted here to provide a holistic understanding of the interconnected relationships between various sectors of the economy and their environmental impacts, specifically focusing on waste generation, disposal, and recycling. Understanding the linkages between the economic activities and waste generation in an IO framework is crucial for both environmental impact accounting through sectoral waste footprints, while also extending the premise of waste to energy (WtE) as a sector in the economy. WtE is a nascently emerging sector in the Indian context, at present only about 66MW is being generated from primarily from incineration in the existing 12 WtE plants across the country. Yet, there is an untapped potential of power generation based on waste generated from industrial and household activities of about 5690 MW. The Ministry of New and Renewable Energy (MNRE) has been incentivizing private players for public private partnership (PPP) towards setting up of WtE plants through capital and revenue subsidy. Furthermore, preferential tariffs are being presented to encourage state utilities to purchase power from WtE plants at competitive rates.
The incorporation of waste IO framework is introduced as a systematic methodology capable of capturing the intricate web of relationships between different sectors of the economy, shedding light on the environmental implications of resource consumption and waste generation along with WtE as a separate sector. The study has undertaken using 2018-19 IOTT for India wherein waste footprints have been determined in physical terms while the WtE sector has been created in

terms monetary flows. The waste footprint analysis delves into the composition of varying waste generated through industrial activities along with potential for reduce, recycle and reuse linkages among the sectors. Meanwhile, introduction of the WtE as a separate sector sets the premise, both in terms of economic accounting of an emerging sector along with the potential of achieving renewal energy demands from rising urban demands. The varied technologies at present and being prospected towards WtE have differing suitability conditions governed by physicochemical properties of the waste, the quantity of waste feedstock, and the desired form of energy. Apart from these physical factors the potential economic costs and environmental implications in the regional context. Hence, we also take into account of these varying suitability and feasibility conditions associated with technologies such as incineration, gasification, pyrolysis, anaerobic digestion, and ethanol fermentation. Such a study is novel both in the model conception of hybrid waste IO frameworks while also enabling to chart unique policy implications and sustainable pathways for development in the regional context of Indian economy.

Prioritizing value chains for agrifood system transformation in India by using Social Accounting Matrix Multipliers

Topic:
Author: Manmeet Singh AJMANI
Co-Authors: Barun Deb PAL, Karl PAUW

Agrifood system (AFS) remains central to the sustainable development goals (SDGs) to eliminate poverty, erase hunger, organize climate actions, and develop an ecosystem for life above the land and below the water. With a population of 1.43 billion and approximately 70 percent of its people living in rural areas, India heavily relies on AFS to support the livelihoods of its low-income households and achieve some of its SDGs. Despite its importance, there is limited literature that focuses on estimating the size of agrifood system, its contribution to national income, unpacking AFS value added between on-farm and off-farm activities across different agrifood value chains (AVCs), and prioritizing AVCs by estimating their backward and forward linkages.

In this proposed study, we aim to estimate above research gaps by using our latest Social Accounting Matrix (SAM) for India for the year 2019/20. To develop India SAM, national accounts statistics for 2022 and the supply-use table for 2019/20 has been used, which is published by the Ministry of Statistics and Programme Implementation (MoSPI), Government of India. Besides national data, we have utilized databases like World Development Indicators from World Bank, and Government Finance Statistics and Balance of Payments Statistics from the International Monetary Fund (IMF) to compile the social accounting matrix for India.

Our India SAM accounts 112 sectors of Indian economy of which 39 sectors are accounted for agriculture and allied activities, 18 sectors are related to agriculture-based processing activities, 4 mining sectors, 24 manufacturing sectors other than agro-processing, 3 sectors related to utilities, 1 construction sector and 23 service sectors including transport and trade. The primary factor input has been classified into 8 types of labor, 4 types of capital and one category of land. The categorization of labor is based on the level of education of the workers and geographical location, that is, rural and urban. The 4 types of capital are crops, live animal, mining, and other financial capital. This SAM distinguishes households into three broad categories like rural farm households, rural non-farm households, and urban households. Households are further disaggregated into per capita expenditure quintiles.

The agrifood value chain comprises primary agriculture, food processing, agrifood trade, food

services, and input supplies. A comprehensive analysis of AVCs requires an economywide database like social accounting matrix (SAM) that considers monetary transactions between production, processing, distribution, consumption, and external trade activities related to AFS. Further, the economywide modeling tools are necessary to prioritize value chains by analyzing the policy related trade-offs between development outcomes like employment and income.

In our study, the agrifood system comprises 28 crops and 4 livestock value chains, and provides monetary transactions between primary production, processing, agrifood trade, food services, and input supplies activities across all the value chains. The systematic estimation of value-added components directly embedded in each transaction within the AFS helps us measure the overall value added by the AFS and the share of off-farm activities in that value addition across all value chains. Further, we use SAM multiplier model to help us prioritize AVCs in India based on their contribution to income, and employment.

Keywords: Agriculture, Agrifood, India, Social Accounting Matrix
JEL codes: O130, Q130, O530, D570

Environmental Efficiency in the Utilization of Factor Inputs in Japanese 47 Prefectures

Topic:
Author: Kyosuke AKI
Co-Authors: Junji TSURU, Daigo USHIJIMA, Shigemi KAGAWA

In 2013, Japan had a total railway length of 27,445 km. Five prefectures—Tokyo, Osaka, Aichi, Fukuoka, and Hokkaido—accounted for a significant portion, representing 22.3% of the total railway length. Conversely, nine prefectures, including Okinawa and Nagasaki, contributed to a marginal portion, amounting to less than 1% of the total railway length. As a result, infrastructure stock levels varied among prefectures in Japan. It is crucial to note that a higher infrastructure stock level leads to a higher gross prefectural product but also results in larger CO2 emissions due to energy consumption in infrastructure use, such as electricity consumption in railway passenger and freight transport.

On the other hand, despite Japan experiencing a continuous population decrease since 2008, the national government and local authorities have made excessive investments in infrastructure, such as railways. An important research question is how to estimate the potential economic losses and excessive environmental impact resulting from ‘inefficient’ investments in public infrastructure and housing construction necessary for economic activities in a specific prefecture.

With this background, Eguchi (2017) used panel data on the physical stocks of buildings and infrastructure, labor force, and gross regional product of 46 Japanese prefectures during the study period between 1970 and 2010 and identified inefficient prefectures with productivity improvement potentials. It is important to note that Eguchi (2017) did not analyze CO2 reduction potential achieved through efficient factor inputs at the prefecture level. This study is an important follow-up investigation into the relationship between production factor use and the environment. Using data envelopment analysis (DEA), we estimated the environmental efficiency score of factor inputs, including urban stocks, in each prefecture in Japan in 2013 and identified inefficient prefectures.

The input data include the total length of railway lines in each prefecture (Institution for Transport

Policy Studies, 2023), the total number of houses in each prefecture (Ministry of Internal Affairs and Communications, 2023), and the number of employees in each prefecture (Cabinet Office, 2023). The output data consist of the prefectural gross domestic product (Cabinet Office, 2023) and energy-related CO_2 emissions of each prefecture (Ministry of the Environment). The analysis is conducted using both single-input single-output and three-input two-output models.

The results from a simple productivity indicator analysis show that the gross regional product per kilometer of railway line varied significantly across prefectures. For example, Okinawa had the highest value (303.2 billion JPY/km), 12.8 times the national average (23.7 billion JPY/km). In particular, prefectures including metropolitan cities like Tokyo (101.1 billion JPY/km), Osaka (49.7 billion JPY/km), Kanagawa (46.7 billion JPY/km), and Aichi (40.8 billion JPY/km) also exhibited higher values. Conversely, Iwate had the lowest value (4.5 billion JPY/km), which is 0.01 times that of Okinawa. Regions such as Hokkaido (7.4 billion JPY/km), Tohoku including Aomori (6.6 billion JPY/km), and Akita (5.5 billion JPY/km), and the Sanin region including Shimane (5.5 billion JPY/km) showed relatively low values.

Gross regional product per house also varied across prefectures. Tokyo had the highest value (14.43 million JPY/house), which was 1.76 times the national average (8.2 million JPY/house). Other high values were observed in the Tokai and Hokuriku regions, including Aichi (11.25 million JPY/house), Fukui (10.31 million JPY/house), Shizuoka (10.23 million JPY/house), Toyama (10.08 million JPY/house), and Shiga (9.9 million JPY/house). Conversely, Nara had the lowest value (5.91 million JPY/house), which is 0.4 times that of Tokyo. Western Japan, including Kochi (5.95 million JPY/house), Kagoshima (6.08 million JPY/house), Nagasaki (6.39 million JPY/house), Miyazaki (6.46 million JPY/house), and Okinawa (6.49 million JPY/house), showed relatively low values.

Thus, urban stocks contributed to economic outputs, but they have worsened the environment by emitting a huge amount of CO2 during the construction stage of those railways and houses. The results from a combined analysis framework of DEA analysis and infrastructure LCA analysis showed that there is a significant CO2 reduction potential through the efficient accumulation of urban stocks in inefficient prefectures located in the Tohoku and Kyushu regions identified in this study. In conclusion, based on the benchmark prefectures, we suggest infrastructure use guidelines for the inefficient prefectures.

China’s 1997-2017 growth: applying SDA to SAMs

Topic: Structural Decomposition Analysis
Author: Ludovica ALMONTI
Co-Authors: Erik DIETZENBACHER

Between the late 1990s and the outbreak of COVID-19, China experienced an impressive growth trend, boosted by its accession to the World Trade Organization (WTO) in 2001. The country began to play a decisive role on the international stage, opening up to trade in goods and services and receiving large inflows of capital in the form of foreign direct investment (FDI). China sought to stimulate growth through three main channels: public spending, trade, and investment. These policy instruments are seen as the drivers of growth in the years of China's rapid globalization when profound changes in the economic structure took place. In particular the changes between 1997 and 2017 have been addressed in several studies based on Input-Output (IO) tables.
IO tables represent in a comprehensive way the functioning of real economies by recording information on intermediate transactions, primary factors and final demands. They tie industrial

interdependencies, technological features and value-added generation with domestic and foreign final demands. However, IO tables do not provide information on the primary allocation of income and its secondary distribution among institutional sectors. Such information requires the connection of the production structure with the institutional sector accounts. From a policy perspective, IO tables therefore face limitations because they do not display the full circular flow of income.

In contrast, the Social Accounting Matrix (SAM) is a disaggregated accounting scheme that takes the IO table as its starting point and adds information on factor owners' income, inter-institutional transfers and the use of disposable income. In addition, it considers transactions occurring between the residents and the Rest of the World (RoW). These include import expenditures for intermediate and final use, export receipts, incoming and outgoing transfers, and the current account balance. A SAM thus serves as a consistent statistical framework for policymakers that sketches the structure of production (just like IO tables). In addition, however, it also includes the transactions that link the production structure to the distribution of income.

This paper constructs SAMs for China and applies Structural Decomposition Analysis (SDA) to examine the impact of the three policy instruments. First, we construct Chinese SAMs for the years 1997, 2002, 2007, 2012 and 2017. The main data sources are the IO tables and the Flow of Funds tables (the institutional sector accounts) published by the National Bureau of Statistics (NBS) of China. The core information of the SAMs is the production structure of the economy as reported in the non-competitive IO tables. The NBS publishes the IO tables with interindustry transactions at the level of 17 industries. Until 2017, the NBS provided the IO tables with competitive imports. That is, all deliveries (intermediate inputs and final goods and services) include the sum of domestically produced and imported goods and services. These competitive IO tables first need to be converted into non-competitive tables, which separate domestically produced from imported deliveries. This is done with the import scrubbing method based on the import similarity assumption. The SAMs also include two primary factors (labor and capital) and five institutional sectors (financial corporations, nonfinancial corporations, households, the government, and the RoW).

SDA is the technique used in this paper to quantify and describe the contribution of three policy channels to China's economic development process in the period 1997-2017 (distinguishing four subperiods: 1997-2002, 2002-2007, 2007-2012, and 2012-2017). The three policy channels are trade, investment and public spending. Our indicator for trade openness is the increase in exports and we are particularly interested in the effects of China’s WTO accession. Investment includes both public and private investment, while public spending includes both public consumption of goods and services and redistributive policies. We analyze whether the promotion of free trade was the main reason for China's development or whether the transition to a developed country was the result of a combination of targeted investment policies and public expenditure measures. We observe the relative importance of these policies in driving changes in the production system and incomes of institutional sectors.

Typically applied to the IO framework, SDA allows the change in a variable over time to be decomposed into the relative contributions of a selected set of independent determinants. The variables that are decomposed in our study are: the country's shift in domestic production specialization and the changes in income distribution. The exogenous independent determinants include government consumption, investment, exports, factor income from abroad, government transfers to Chinese institutional sectors, and transfers from the rest of the world. The endogenous

A supply-driven framework using product-based structures to assess the vulnerability to imports' restrictions and improve economic performance through import substitution – the case of Brazil, USA, EU27 and China.

Topic: Trade and Global Value Chains Policies
Author: Aleix ALTIMIRAS-MARTIN
Co-Authors: Joaquim J.M. GUILHOTO

Supply restrictions such as those induced by the covid-19 pandemic, or the war in Ukraine, have stressed the importance of international trade to economies. Specifically, certain imports have the potential to disrupt production and consumption. Such issues are pervasive across countries and can be sparked by restriction of many products (e.g., food, energy, specialised electronic components, critical materials…). Hence, identifying and characterising such vulnerability is a priority to build resilient economies without losing the advantages brought by international trade for the nation's economic development and well-being.

The literature has already explored similar issues. At the domestic level, the Ghosh model has been used to study supply restriction. Unfortunately, the Ghosh model does not reflect the actual functioning of the economy since it considers primary inputs as independent. Thus, such exercises do not reveal the actual productive disruptions caused by import restrictions. More recent literature used (Global) Multi-Regional Input-Output Tables (G)MRIOTs to capture and decompose the different impacts of Global Value Chains (GVC). However, most analyses and indicators rely on demand-driven models and the Ghosh model. Thus, it is still difficult to fully assess the consequences of supply restrictions.

Hence, currently, it is still not clear how specific import restrictions affect the productive capacity and structure of an economy, nor their impact on the country's value added (VA) and employment. It is unknown how each sector's imports may restrict the overall production and consumption of the country. Neither it is known the impacts on VA, employment, if specific import restrictions were to happen and cascade through the economy.

The first part of this paper uses a recently developed supply-driven model which consumes simultaneously all primary inputs to characterise a country's vulnerability to imports using new indicators, unavailable through the Ghosh model. The new indicators are final demand, labour, imports and value-added supply-driven multipliers and total forward linkages, all considering the simultaneous consumption of all primary inputs. In this study, these indicators will be driven by imports and value added, resulting in a set of 10 different indicators. E.g., the final demand multipliers supply-driven by imports correspond to the total amount of final production associated with the consumption of a unit of import of a given sector.

However, using the new supply-driven model on the aggregate structure masks the actual functioning of the economic structure, whose inputs are consumed to produce specific final products/services. Therefore, this paper expands previous attempts to use the new supply-driven model by applying it to the n different product-based structures of the economy, constituted by the primary inputs and intermediate flows associated with each final product. Each product-based structure provides different results for the same indicator, resulting in a set of 10 x n indicators to analyse.

The model is applied to OECD's Inter-Country Input-Output (ICIO) tables to perform a comparative analysis. This method is especially suited to account for non-competitive imports, but variations

of this methodology can also be applied to competitive imports. In particular, it is used to calculate production multipliers associated with every import to identify their respective capacity to disrupt domestic production, VA and employment.

In a second part, this paper aims to assess the structural effects that imports have on the domestic productive structure. In particular, a new method of hypothetical extraction of imports is developed and applied to a conventional IOT, revealing the “pure domestic” productive structure. The method extracts all flows associated to imports: i.e., imports accounted as primary inputs, their corresponding intermediate flow, and final outputs. Then, the structure is scaled to match actual fd using the original structure and the resulting structure is compared to the “conventional domestic” productive structure, which includes imports by default. In our case, we calculate the total backward linkages, and value-added and employment multipliers, using the Leontief model of the “pure domestic” and “conventional domestic” structures. We assess the differences in results from both structures to deepen the understanding on how imports affect the domestic economic structure.

The results allow researchers to: 1) identify the imports’ supply restrictions with most economic impacts, in terms of total production, value-added and employment; and 2) identify how the domestic structure of economies is altered due to their own import needs, providing key information to internalise the production of imports.

Regional CO2 Emissões: a systemic temporal analysis

Topic:
Author: Gabriel Marcos ARCANJO
Co-Authors: Juliano da Costa DA SILVA, Fernando Salgueiro PEROBELLI

The interest of this article lies in the rise of global discussions that have been intensifying countries' decarbonization commitments, mainly through the adoption of production systems that are capable of stimulating sustainable practices and mitigating environmental impacts, especially greenhouse gas emissions. Brazil, in turn, attracts global attention when it comes to these aspects, particularly due to its vast regional and environmental diversity, potential for agricultural production and insertion in international trade. Therefore, this article aims to address the topic through a model that allows innovating discussions regarding the spread of emissions in a systemic, sectoral, and spatial context for Brazil. In other words, understand the degree of the production chain in terms of economic links and emissions. To this end, the inter-regional input-output matrices were used with a spatial disaggregation for 27 units of the Federation for the years 2011 and 2015 made available by the Center for Regional and Urban Economy of the University of São Paulo (NEREUS). Data relating to emissions are found in the Greenhouse Gas Emissions and Removals Estimation System (SEEG), but at a regional and sectoral level the data were provided by NEREUS. The empirical strategy used consists of the combination of systemic analysis methods. The first step was, through an adaptation of the Rasmussen and Hirschman indicators, to obtain a classification of the Federation units in terms of their importance both in economic terms and in terms of CO2 emissions. The second step was to build a typology of the 27 units of the Federation based on both the economic indicator and the emissions indicator. Finally, the third step was the implementation of the Structural Decomposition Analysis (SDA), based on the typology constructed in the second step, to investigate the main driving forces behind the variation in CO2 emissions (e.g. intensity effect, final demand effect, disaggregated for households. The main results reveal that agricultural sector is identified as the main source of emissions in Brazil, particularly in states where these sectors have a low participation in the value

added of the production chain. Another contribution lies in the spatial analysis, as regions with biomes important for the ecosystem, such as the Amazon, is surrounded by states with higher levels of emissions. Finally, the increase in CO2 emissions is mainly incorporated into commodity exports and is negatively correlated with technological progress. and exports and technological effect)

Climate-related direct, indirect and induced impacts: evidence for Bangladesh

Topic: Disaster analysis
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Co-Authors: Marina SáNCHEZ, Jorge E. ZAFRILLA, Ángela GARCíA-ALAMINOS

The threat of climate change is a reality for many emerging countries, and it may jeopardize their future development. Bangladesh is a good example; it has been suffering the effects of extreme weather events in recent years, such as floods, cyclones, significant storms, and droughts that have caused, on average, GDP losses in 2016-2021 of up to 1.32 percent per year (Government of the People's Republic of Bangladesh, 2022). Bangladesh is considered the seventh most vulnerable country to climate change, and its population is threatened with displacement shortly. One in seven Bangladeshi citizens is estimated to be displaced by climate change (ILO, 2023). Extreme climate events affect primary industries such as Agriculture, Fisheries, and Livestock (Bangladesh Bureau of Statistics, 2021), so the socioeconomic profile of the climate migrants would be concentrated in low-skilled workers from rural (and coastal) areas (ILO, 2023).

The future economic performance of the country could be compromised, so in this paper, we propose using an input-output disaster model to estimate the total (direct, indirect, and induced) value-added impact given the potential disruptions of the supply chains downstream (Arto et al., 2015; Huang et al., 2022; Lenzen et al., 2019). To capture induced effects, we propose developing a SAM (Dejuán et al., 2013) for Bangladesh with rural and urban household differences to evaluate how economic impacts would increase the degree of vulnerability of the country (Okuyama and Santos, 2014).

Although the urban population in Bangladesh has grown up to 39.7 percent of the total population in recent years, generating an exacerbated increase in urban population density ADB (2023), the Agriculture sector dominates the Bangladesh economy structure with the highest value-added generation and employment, while in terms of total output, Construction or Textile industries appears as dominant. Trade figures show the increasing immersion of Bangladesh in the global value chains for the Textile industry with an outstanding sextupling of the total exports, which is dominated, by large, by foreign value added.

Preliminary results show how extreme events forcing climate migration in Agricultural sector, estimated in a -8.2 percentage shock total in output and -16 percentage points in value, would be transferred, besides the Agricultural sector (17.6 percentage point), to mainly, the manufacture leading industries in Bangladesh, such as Textiles (-8.5%), Machiner (-9.5%) and Electrical and optical equipment (-8.1%). Regarding value-added embodied in exports, more significant shocks are generated in main manufacturing sectors, with a higher incidence in the Textile industry. These results confirm the necessity to assess the effects of climate change on the economic performance of most vulnerable emerging economies as its consequences can compromise the pillars of their recent and globally motivated economic awakening. Further research on spreading the shock in terms of households' reduced income and expenditure using the SAM model and the

effects of displacements from rural to densely populated urban areas is expected to fulfill all the paper's goals.

Beyond Commodities and Industries: Accurate Measurement of Upstreamness in the Global Value Chain

Topic: Trade and Global Value Chains Policies
Author: Patricio AROCA
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In two seminal papers, Antràs and Chor (2013, AC) and Antràs et al. (2012, ACFH) addressed the problem of measuring the degree to which industries are upstream or downstream in the global value chain. A growing number of publications have built upon their measurement formulation and accompanying computer code. Unfortunately, however, their implementation seems to be incorrect. The reason is that they work with data from supply–use tables (in a commodity-by-industry accounting framework) which are then processed as if the data were given by the interindustry flows from a standard input-output (IO) table. This paper takes the typical commodity-by-industry perspective into full account and derives two measures for upstreamness: a measure for the upstreamness of an industry and one for the upstreamness of a commodity. The difference between the standard Leontief-type IO table and the supply-use table developed by Stone is that the IO table assumes that each industry produces one and only one commodity. Stone's framework recognizes that most industries produce more than one commodity, and most commodities are produced by more than one industry. This allows for taking secondary production into consideration. In this paper, we develop and implement properly formulated value chain metrics taking the Stone enhancements and their conceptual underpinnings into full account. We compare our results to the results from the incorrect formulations in AC and ACFH. We show that incorrect formulations have substantial empirical manifestations for some industries but not for other industries. We explain why this is the case.

Beyond Disguised Employment: Stagnation and Informal Employment in Brazil

Topic: Employment Policies
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Brazil experienced a period of relatively higher economic growth from 2003 to 2014, when the labour market improved in terms of higher formalization and lower unemployment rate. After 2012, the country presented different growth patterns: a deceleration period (2012-2014), a recession (2015 and 2016), and stagnation from 2016 to 2019. The country has experienced a reform agenda centred on austerity measures and the reduction of state capacities since 2016, undermining economic policy instruments to stimulate economic growth, reduce unemployment and improve labour formalization and income distribution. The recession decreased employment, but the low economic growth rates during the stagnation period raised the level of employment, making employment in 2019 higher than the employment in 2014. Despite this, informal employment increased considerably from 2014 to 2019.

The aim of this paper is to investigate the Brazilian labour market from 2014 to 2019 and evaluate how changes in the Brazilian growth pattern contributed to increase informal

employment. We classify workers according to their formalization status, sector of activity, occupation and income to understand the changes that occurred in the Brazilian labour market in the considered period. We, then, develop a structural decomposition analysis to measure the demand components' role in explaining the Brazilian labour market's transformations based on an effective demand input-output model.

The results show that employment decreased from 2014 to 2016 and it increased from 2016 to 2019, achieving a different sectoral composition, with a reduction in Construction, Manufacturing industry and Agriculture, and an increase in Commerce, financial intermediation and service. The decrease in employment from 2014 to 2016 was associated with the decrease in investment and the employment coefficient indicated that formal employment was replaced by informal employment for the private sector and that there was a decrease in both formal and informal employment for the public sector. The crisis also increased the own-account employment, both formal and informal. Part of this employment reflect disguised employment, when the worker perform functions as an employee but he/she is not classified as one, as part reflect informal employment as a consequence of a job loss that made the person to find another way to receive an income to survive. Exports had an important role for the resumption of employment from 2016 to 2019, but the main change was associated with a change in the employment coefficient from formal to informal, indicating the precariousness of employment growth. In this last period, disguised employment becomes more prominent.

Structural change in Minas Gerais and in Brazil between 2008 and 2019: an input-output analysis

Topic: Regional Analysis
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This article investigates whether the drivers of structural change in Minas Gerais (MG) and Brazil (BRA) between 2008 and 2019 were similar. The paper aims to answer this question by employing a structural decomposition technique based on input-output models for both MG and BRA. Data, including input-output tables and sectorial price indexes, were sourced from the Brazilian Institute of Geography and Statistics (IBGE) and the João Pinheiro Foundation (FJP). The research is novel in two aspects: firstly, it compares structural changes between a national entity and a regional one; secondly, it explores structural shifts at both national and regional levels during a recent period characterized by distinct economic cycle phases, enhancing the study's relevance.
MG, the country's third-largest economic region, contributes approximately 10% to the Brazilian Gross Domestic Product (GDP), with São Paulo accounting for about 30% and Rio de Janeiro for 12%. It serves as a microcosm of Brazil, embodying both relative affluence in the South and economic underdevelopment in the North. The state shares borders with other BRA regions, and its subregions somewhat mirror the socioeconomic patterns of neighboring states. Remarkably, since Brazil's redemocratization, the state has consistently played a pivotal role in national elections, with the presidential candidate most favored in MG emerging as the overall winner.
However, MG's economic structure differs from that of BRA. On the supply side, between 2002 and 2021, the share of value added in agriculture averaged 5.6% in BRA and 6.2% in MG; for industry, the figures were 25.2% and 29.8%, and for services, 69.2% and 64.1%, respectively. On the demand side, in 2008 and 2019, household consumption expenditure constituted over 50% of final domestic demand in BRA but only around 40% in MG. Investment shares were higher in the former, while international exports were similar, at around 10%. Additionally, a subnational

region exports to other regions, and for 2008 and 2019, the exported value by MG to other states was at least twice as large as international exports.
In BRA and MG, the period from 2004 to 2019 witnessed a significant increase in economic activity, followed by a subsequent deceleration, collapse, and eventual stagnation. Between 2004 and 2010, the average annual growth exceeded 4%, propelled by the rise in commodity prices, accompanied by robust consumption and investment growth, along with improved income distribution. However, in the subsequent years (2011-2013), the growth rate averaged 3% in BRA and 2.1% in MG, indicating the limitations of the economic growth cycle. During this timeframe, there was a shift in macroeconomic policy to stimulate private industrial investment. This involved implementing measures such as lowering interest rates, cutting energy prices, devaluating the exchange rate, providing tax subsidies. Then, one of the most severe economic downturns occurred, resulting in a cumulative GDP decrease of over 6% between 2014 and 2016. Several economic shocks, including the decline in commodity prices, a water crisis, and a political and institutional crisis, contributed to this downturn. The period from 2017 to 2019 saw a sluggish recovery, with the GDP averaging slightly over 1% annually. Thus, the GDP did not regain its highest level achieved in 2014 in BRA and in 2013 in MG.
During these growth cycles, observed both nationally and regionally, the industrial sector contracted, while the service sector experienced expansion. Notably, in 2019, the manufacturing sector in BRA reached its lowest GDP share since 2002, accounting for 12%, compared to 15.3% in 2008. In MG, where the industrial sector holds more prominence, a similar trend unfolded, aligning with the national scenario. Brazil, akin to other Latin American nations, underwent premature deindustrialization, initiating the process much earlier than historically anticipated. This trend persists, evident in the latest available data.
To probe the key factors behind this structural change, we employ a structural decomposition technique, unraveling the influences of technological advancements and shifts in final demand. This methodology involves several steps. Initially, we need to construct input-output matrices for the Brazilian economy for 2008 and 2019. While matrices for MG are available, it is crucial to note that they were not regionalized based on the national matrix, ensuring unbiased results. The second step involves standardizing the matrices to make them comparable by adjusting for varying sectorial classifications. Additionally, input-output tables for BRA contain sectors that require grouping to align with those available for MG. The final step entails deflating the values from the input-output tables using the double deflation methodology, measuring real value added as the difference between real gross output and real intermediate outputs.

Estimating energy demand in a Stock-Flow Consistent model: preserving household heterogeneity in the green transition scenario

Topic: Sustainable Production and Consumption Policies
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1. Overview

The energy transition is the main path that all types of economies will have to follow in the coming decades to contain the effects of climate change. Such a transformation path undoubtedly requires profound technological changes and calls for a careful and continuous assessment of the economic impact that society will have to face. Technological changes and their likely associated regressive effects on consumers require specific policy responses. A forecast of long-term changes in energy consumption choices and habits is necessary to predict the response of households to these policies, which will be progressively introduced with the aim

of managing the energy transition in a context of likely enduring international uncertainty.
This paper investigates the energy consumption behavior of households, both for residential and mobility purposes, on the basis of socio-economic determinants such as demographic characteristics, income, prices and accumulated wealth. In particular, we emphasize the relevance of generational affiliation for long-term changes in the structure of consumption through the long-term influence of experiences, norms and information that can act differently on the behavior of heterogeneous subjects (Bardazzi and Pazienza, 2020, Malmendier e Shen, 2024, Bjelle et al., 2021).

2. Data and methods

The methodological approach is based on a long-term structural demand system, which uses both cross-section and time series data (Almon, 1998; Bardazzi and Barnabani, 2001). In this paper we estimate the pure effects of age and cohort on sectoral household consumption and with feedback effects on the demand system. The originality of the approach lies not only in the understanding of family disaggregation by age (Kim, Kratena and Hewings, 2015), but also the generational heterogeneity that persists at different ages. This source of heterogeneity is relevant in economic modelling of the long-term path of the energy transition (Dubois, et al. 2019).
The demand system is based on national accounts data provided by the Italian Statistics Office and on the annual Household Budget Surveys enriched with information on energy prices and taxes. Furthermore, the Bank of Italy dataset is utilized in order to introduce the effect of accumulated assets on household consumption behaviour.
The consumption functions are estimated as a stand-alone econometric model and then integrated into a national Inforum-type stock flow consistent multisectoral model of Italy. Subsequently, the change in the structure of energy consumption generates sectoral effects on production, income and employment, which propagate throughout the economy according to the structure of inter-industrial exchanges. Predictions of changes in demand are then compared through the counterfactual (when demographic variables are excluded from the model). The analysis therefore considers multiple simulations to evaluate the properties of the most coherent specification of the demand system estimate.

The final aim of this research is to link the economic model with an optimization energy model to complete the analysis of energy transition paths. This linkage will be bi-directional and time-specific: energy demand will be passed to the energy system and feedbacks will return in terms of produced energy mix and costs of energy technologies used.

3. Novelty

The research is characterized by its focus on the socio-economic determinants of different energy consumption behaviors. The objective is to estimate the long-term effects on the structure of the energy needs of households for mobility and housing coming from different socio-economic profiles. In particular, we try to understand the effects on the composition of household consumption determined by the main demographic aspects (age, cohort, volume and structure of the population), accumulated wealth, prices and disposable income.
The reason that pushes the research towards this direction is that, within the literature, a significant diversification has been found in the response of households through a change in consumption to different policy impulses (Biley et al. 2022). These differential effects can be traced both in generational membership and age, especially in relation to accumulated wealth and income. For a complete treatment of how the stocks of wealth influence consumption behavior in the long run the model also takes stock-flow consistent (SFC) relationships into account. The quadruple accounting typical of the SFC models (on the one hand, the incoming and outgoing flows between institutional sectors, on the other, the respective asset and liability

stocks accumulated in each period as result of the latter flows) allows a dynamic understanding of the relationships that we consider as determinants of long-term changes of household energy consumption.

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Impact of cash transfer payment on poverty reduction in Iran, Social Accounting Matrix Approach

Topic: Income distribution policies

Author: Fatemeh BAZZAZAN

ABSTRACT

The reduction of poverty is a fundamental objective for governments worldwide, as it represents a crucial step toward achieving inclusive and sustainable development. In Iran, like many other developing countries, poverty remains a pressing issue that requires effective intervention strategies. Cash transfer payments have emerged as a popular policy tool aimed at addressing poverty, providing financial assistance to vulnerable populations, and improving their living conditions. This paper explores the impact of cash transfer payments on poverty reduction in Iran, employing the Social Accounting Matrix (SAM) approach to analyze the economic and social dynamics associated with these interventions.

Iran has implemented various cash transfer programs over the years, such as the Targeted Subsidy Plan, the Imam Khomeini Relief Foundation's Cash Transfer Program, and the State Welfare Organization's Family Support Program. These initiatives aim to alleviate poverty by directly transferring cash or subsidies to eligible households, targeting those who are most in need. By examining the effects of these programs through the lens of the SAM framework, we can gain insights into the broader economic implications of cash transfers and understand the mechanisms through which poverty reduction occurs. The Social Accounting Matrix (SAM) approach provides a comprehensive framework for analyzing the interactions between different sectors of an economy, including households, businesses, and government. It allows for a detailed examination of the income distribution, resource allocation, and the multiplier effects of policy interventions. By utilizing SAM models specific to Iran, this study seeks to quantify the direct and indirect impacts of cash transfer payments on poverty reduction, as well as their potential spillover effects on employment, consumption patterns, and overall economic growth. Understanding the complex relationship between cash transfer payments and poverty reduction is crucial for policymakers, researchers, and development practitioners aiming to design effective social protection programs. By assessing the efficiency and effectiveness of existing cash transfer initiatives, policymakers can make informed decisions regarding program design, targeting mechanisms, and resource allocation. Moreover, this research can contribute to the ongoing dialogue on poverty reduction strategies, providing empirical evidence on the role of cash transfers within the broader context of Iran's socioeconomic development.

In summary, this work aims to examine the impact of cash transfer payments on poverty reduction in Iran using the Social Accounting Matrix (SAM) approach. By analyzing the economic and social dynamics associated with these interventions, we seek to shed light on the effectiveness and potential challenges of cash transfer programs in alleviating poverty. Ultimately, the findings of this study can inform evidence-based policy decisions, contributing to the broader goal of achieving sustainable and inclusive development in Iran. For this purpose, First, the cash transfer payment is defined and its impact on the whole economy. Second, the

research methodology (social accounting matrix approach) is introduced to evaluate the transfer payment policy on poverty reduction. Third, the research methodology is tested in Iran using the new 2016 SAM is published recently by the Central Bank of Iran.
Fourth, the results will be drawn and compared with other countries' experiences. Fifth, some recommendations and suggestions for future research will be given.

The impacts of technological improvements on water uses and virtual water trade in Uzbekistan

Topic: Sustainable Production and Consumption Policies
Author: Maksud BEKCHANOV

Technological improvements and virtual water trade are two main options for enhancing water management in water scarce environments. The combined analysis of their effects on economic systems and water allocation have not been addressed. Furthermore, the diverse understanding of the virtual water concept and differing assessment techniques further complicate the debates surrounding the policy relevance of virtual water trade. This study applied Computable General Equilibrium (CGE) modeling approach to analyze the impacts of technological change on production, water uses and virtual water trade. Through this way, non-water determinants (labor, capital, fertilizer) of production and trade are included in virtual water assessment. Additionally, a novel method was developed to evaluating virtual water content and flows using the advantages of Input-Output methods within CGE framework. The quantification of the method is exemplified in the case of Uzbekistan (Central Asia) where water is a limited yet essential resource for sustainable economy and environmental systems. Data to build the Social Accounting Matrix and sector-specific water use accounts were obtained from statistical bulletins and reports of water and agricultural ministries in Uzbekistan. The findings reveal a high sensitivity of virtual water flows to technological changes. The study also shows that enhancing productivity in livestock and fodder crops production are advisable to reduce net virtual water exports and improve economic growth in Uzbekistan.

Measuring the potential impact of developing the lithium value chain in Argentina: An Input-Output analysis

Topic: Industrial policies
Author: Pablo Federico BERTIN

Argentina has a privileged situation for the Lithium Value Chain (LVC) development since it accounts for 22 percent of worldwide lithium resources and a great number of exploration projects in lithium extraction. The objective of this paper is to present and analyze the potential quantitative socioeconomic impacts of the development of the LVC in Argentina. To address this purpose, the elaboration of a multi-sectoral (35 sectors) Input-Output matrix with its associated Satellite Account of Employment (SAE) was developed for 2017. In order to productive activities, the analysis of LVC is disaggregated in 6 sectors: lithium extraction, lithium cells for lithium-ion batteries, lithium-ion battery packs, utility scale solar panel installation; electric vehicles and renewable electricity generation. The complementary accounting information of lithium enterprises about cost and sales, academic papers and national government documents are some of an essential input for the generation of these sectors. The use of different types of labor sources can amplify the number of jobs in the economic activity in Argentina because of the relevance of informal jobs in the labor market. The chosen year has to be the most recent and

stable one for the economy in order to have no crisis, no pandemic and no war. The Input Output matrix and the SAE are the calibration base for an Input Output model used as simulation tools. Three prospective scenarios about the LVC development in 2030 have been designed taking into account official targets for sectors which could be a source of demand for lithium and the possibility for disaggregating the impacts according to investment and production phase. Results highlight that under all scenarios net socioeconomic impacts are positive until 2030. Spillover effects through the economy become significant with a deeper ambition on the development of the LVC, particularly with large scale lithium projects that demand inputs and services from other sectors and, in a minor way, when downstream LVC sectors start producing by 2030.

Measuring dependencies on critical raw materials in the supply chain

Topic: Special Session: Supply chain on critical raw materials
Author: Timon I. BOHN
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In the European Union there is growing attention directed to securing Europe's supply of critical raw materials (CRMs), which are seen as vital in facilitating the energy transition in the scope of the European Green Deal. Consider for example the EU's Critical Raw Materials Act (2023) or the European Chips Act (2023). These measures can also be seen as a response to a surge in geopolitical competition and a desire to become more strategically autonomous and sustainable in the sourcing of vital materials. These developments lead to the question: how dependent is a country – directly and indirectly, via the global supply chain – on CRMs supplied by countries like China or Russia?

We quantify the import of 32 CRMs into the Netherlands, analyze their origin, and trace their use in the Dutch economy using a value chain framework. We consider both direct product-specific dependencies (via the direct import) and indirect or otherwise 'hidden' dependencies. The latter involve the indirect import from third countries, i.e., via the direct import of products that embody CRMs that were traded upstream in the chain. For example, copper from Chile may be indirectly imported by the Netherlands if is first exported to China for processing and then crosses the Dutch border at a later stage embodied in a processed good (such as solar panels or wind turbines). Our approach explicitly takes that aspect into account.

A novel IO-based framework is employed that builds on the general concept introduced in Lemmers et al. (2023). To compute direct imports of CRMs, we use a 'national TiVA' approach by linking micro-data on international trade to national Dutch input-output tables (following Aerts et al. (2022) and Lemmers and Wong (2019)). The imports in the IOT are split at the country by industry by 8-digit product level and benchmarked to national account totals. This national TiVA approach is more timely and, crucially for our aim, has much more detail on both countries and products than a conventional IOT. For example, this allows to compute the amount of bauxite directly imported by the Dutch basic metal industry from Guyana that is ultimately processed in Dutch exports, or the import of the same product bauxite from China that may mainly go directly into Dutch re-exports.

The calculation of indirect imports involves allocating detailed trade data to all trade flows between countries and industries in the OECD Inter-Country Input-Output Table. We draw upon supply tables from the FIGARO MRIO, BACI international trade data (with HS-6 product level detail), the Dutch use table, and the BEC classification to provide this added layer of granularity.

This 'global' supply-use table, which has been merged into the MRIO and is combined with detailed national data, allows to estimate the amount of production required directly and indirectly in all upstream chains (of different CRMs) to produce Dutch imports. This shows us how much nickel is indirectly imported from Russia via the direct import of stainless steel from the US.

The analysis shows that most of the direct import of CRMs in 2022 ultimately ended up abroad, either in the form of re-exports (57 percent) or in the form of imports processed by Dutch industries into exports (30 percent). Much of the rest (12 percent) went into Dutch consumption after domestic processing. Russia was the most important supplier, both directly and indirectly, of CRMs to the Netherlands in 2019, especially in the form of copper, nickel, and phosphorus. Notably, the indirect imports were in total twice as large as direct imports. This confirms the presence of significant 'hidden' linkages. For example, we find sizable flows of copper and lithium from South America to China that traverse a long distance before entering the Netherlands, which underscore potential indirect vulnerabilities.

One limitation of the method is that the extraction of raw materials that are processed into (intermediate) products within a country before crossing that same country's border is not considered in our analysis of indirect dependencies (due to their lack of visibility in trade data). In future research we plan to address that part as well by examining the indirect import of products that are known to embody CRMs. For example, think of Chinese exports of LEDs that may embody gallium produced in China and imported indirectly via Germany in the form of electrical appliances.

Our paper thus demonstrates the potential of using detailed trade data to increase granularity in both national IOTs and in publicly available MRIO's. The combined use of the more detailed data allows for even more granular insights into the supply chain, which is especially useful where product-specific detail is necessary to address policy-relevant issues.

Nearshoring, global value chains' structure and volatility

Topic:
Author: Filippo BONTADINI
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The debate on the role of GVCs in economic growth has gathered significant attention over the past few decades, especially in light of the recent slow-down of global integration and economic growth. Furthermore, the COVID-19 pandemic and the war in Ukraine have laid bare key dependences of production systems vis-à-vis foreign suppliers and raised questions concerning international fragmentation, its structure, and the propagation of shocks.
A trade-off has taken place, in the policy debate, between economic efficiency and security (Baldwin and Evenett 2020). This is reflected in the Inflation Reduction Act in the US, the emerging idea of "open strategic autonomy" in Europe and the growing tensions around the supply of key materials for the green and digital transitions.
As a result, GVCs' role within the global economy has come into question on two accounts. First, the intensity, i.e. whether the degree of participation in GVCs is linked to higher exposure to shocks. For example, on the one hand, the implementation of very strict measures to contain the spread of the pandemic across the world has brought production processes that heavily relied on foreign inputs to a halt. On the other hand, GVC participation allows firms to access a broader supplier base, making relationship-specific investments that improve resilience to local shocks.

Second, the debate on GVCs has also focused on changes in the structure, rather than the intensity, of GVC participation. The recent disruption of international trade flows has drawn attention to the need to diversify and shorten production. In the current, more turbulent, economic context it has become relevant to consider what changes GVCs should undergo in order to ensure economic production. Specifically, the notion of nearshoring has drawn significant attention in the policy debate to the future of GVCs.

It remains, however, unclear what structural features of GVCs are important in this debate as nearshoring, shortening, and concentration are hard to distinguish from one another. The most intuitive interpretation of nearshoring would be to bring production stages closer to final demand. Shortening of GVCs implies a reduction of the degree of fragmentation and a reduction of the number of intermediate stages. The idea of diversification focuses on reducing the concentration of suppliers.

Literature on international business has devoted significant attention to the issues of reshoring, backshoring and nearshoring, providing qualitative evidence and a discussion of the firm level drivers. However, there is currently no systematic quantitative evidence exploring how different GVC structural features and production are related to each other. We set out to remedy this not only by studying the association between GVC final output growth and their structure, but also by focusing on the propagation of supply shocks. We ask, specifically, two interrelated key questions. First, we assess whether GVC participation increases exposure to shocks, hampering GVC output. Second, we study whether GVC structural features, such as nearshoring, length and concentration, mediate supply shocks and their relationship with GVC output growth.

To achieve this, we use the latest inter-country input-output (ICIO) tables, compiled in 2021 by the OECD. Our unit of analysis are GVCs across countries, i.e. a vertically integrated sub-system (Pasinetti 1973), and we identify GVCs by their country of completion, in line with the methodology developed by Los et al. (2015).

We then compute real output growth for each GVC in each country of completion and calculate measures of GVC integration and its structure. Concerning the latter, we focus in particular on measures of (i) farshoring, following Los et al. (2015), (ii) GVC length as in Antràs et al. (2018) and (iii) GVC concentration (Jimenez et al. 2022). We combine ICIO data with the World Bank global database on inflation (Ha et al. 2023) to compute price volatility for each GVC, which we use to study the interaction of supply side price shocks with GVC participation and its structure.

Our results suggest that GVCs that are more domestic, i.e. production processes sourcing little value added from abroad, see slower real output growth and have a stronger negative association with supply shocks. Among the structural features of GVCs we find more heterogenous results. The length, i.e. the degree of fragmentation of production, is associated with slower growth in GVC’s real output but at the same time seems to attenuate the negative relationship between supply shocks and real GVC output growth. These results offer novel evidence and contribute to a nuanced understanding of how GVC integration and its structure relates to output growth and the propagation of shocks. We discuss these results in the context of the revived interest in industrial policy and strategic autonomy in Europe.

References are available in the attached paper draft.

Analysing the impact of technological change and automation on sectoral employment: An input-output approach

Topic: Employment Policies
Author: Fahd BOUNDI

This research analysed the impact of automation and technological progress on employment in various sectors across 43 countries from 2000 to 2014. The study used data from the World Input-Output Database (WIOD) to calculate vertically integrated labour productivity and vertically integrated capital-labour ratio as indexes to measure the effect of technical change and automation on the number of workers employed. The contribution of our research to literature is twofold. First, the vertically integrated labour productivity and the vertically integrated capital-labour ratio were calculated as indexes to measure technical progress and mechanisation, which overcome the limitation of traditional indicators such as the expenditures of research and development or the total factor productivity. On the other hand, we employ the Dynamic Common Correlated Effects Estimator Mean Group with instrumental variables (CCEEMG-IV), which is robust in the presence of cross-sectional dependence, slope heterogeneity, structural breaks, stationarity, and endogeneity. The sample was divided into advanced economies and emerging markets to observe if there were any differences related to the degree of development of the countries in the sample. Manufacturing and non-manufacturing sectors were distinguished to determine which industries are more vulnerable to technological change and automation. The sample was also decomposed into high and medium-high-tech intensity sectors, medium-tech intensity sectors, and medium-low- and low-tech intensity sectors to proxy the difference between skilled and unskilled labour. The results suggest that technological change and mechanisation may displace human labour, although the effect differs among countries, sectors and labour qualifications.

The socioeconomic impacts of electrolytic ammonia in Brazil: an input-output analysis

Topic:
Author: Kalyne Silva BRITO
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Decarbonizing ammonia production could contribute to the transition to a low-carbon economy. Traditionally, ammonia is produced through the Haber-Bosch synthesis process, which consists in a chemical reaction between hydrogen (H2) and nitrogen (N2). This process is highly polluting, since the H2 used is produced by natural gas steam reforming, corresponding to 2% of annual global greenhouse gas (GHG) emissions. About 77% of global ammonia production is used to produce nitrogen fertilizers such as urea. For Brazil, changing ammonia production technology is particularly interesting since ammonia supply has become heavily dependent on imports, due to logistical and tax issues in the sector, Petrobras inactivated its fertilizer factories, as well as the rise in natural gas prices. However, with the recent announcement of Petrobras' Strategic Plan for the 2024-2028 five-year period, the possibility of resumption ammonia production in Brazil and replacing the use of fossil hydrogen with low-carbon hydrogen has emerged. In literature there are few works that applying input-output analysis for the hydrogen value chain, and the most part focuses in the transportation sector. There is a lack of works that analyses the economic impact of the low-carbon hydrogen production and use, especially in Brazil. The present work aims to analyze the socioeconomic impacts of decarbonization and nationalization of ammonia imports in Brazil. For this, two scenarios were evaluated using a demand-driven Leontief model based on the

Brazilian Input-Output Matrix for the year 2018, with a disaggregation level of 68 sectors/sectors. The matrix was obtained from the Center for Regional and Urban Economics at the University of São Paulo (NEREUS). The scenarios were designed based on a data survey from literature on investment (CAPEX) and operational (OPEX) costs for an ammonia plant construction and operation, as well as data available in the databases of Brazilian government agencies. For this analysis was considered an ammonia plant with a capacity of 219.2 thousand metric tons (kt) per year and the hydrogen used would be produced by water electrolysis using renewable energy. The ammonia plant capacity was defined based on the amount of ammonia imported in Brazil in 2018. To supply the ammonia plant, annual hydrogen production must be 38.6 thousand tons, which means an electrolyzer with a capacity of 232 MW. The first scenario evaluates socioeconomic effects with the increase in final demand from the investment in the infrastructure necessary for the synthesis of renewable ammonia production (construction phase). Due to the lack of available data, it was considered that the technologies used to produce ammonia and H2 are manufactured in Brazil, which means that the results obtained for the first scenario may be overestimated. The second scenario aims to represents the operational phase of the new plant and is constructed by altering the technical coefficient matrix using data tecno-economic analysis data renewable ammonia prices. With the new Brazilian input-output matrix, a shock in the final demand was applied to evaluate new industry impacts on economy (operation phase). In this scenario was considered that all ammonia produced will be consumed to produce nitrogen fertilizers (chemical sector). The analysis of the results was carried out using conventional indicators as Gross Domestic Product (GDP), number of jobs, output multipliers, backward (BL) and forward linkages (FL). The results show that in the construction phase there was an increase of BRL 696 million in GDP (0.01% of 2018 GDP) and an increase of 9.80 thousand jobs, with 74% having been generated by direct effect. In the operation phase, the electrolytic ammonia sector was responsible for an increase of BRL 398 million in GDP and 2.95 thousand jobs, 67% of which were generated by indirect effects. The production multiplier of the ammonia sector was 2.51, which implies that it can contribute to the economic growth in Brazil. Furthermore, BL and FL are greater than 1, meaning the ammonia sector is a key sector for the economy. The results demonstrate that at all stages the implementation of a renewable ammonia sector will result in positive socioeconomic impacts.

TiVA indicators for services by mode of supply

Topic: Trade and Global Value Chains Policies
Author: Mattia CAI
Co-Authors: Sebastien MIROUDOT, Carmen ZüRCHER

Services represent a very significant part of the global economy. In OECD countries, for example, they are responsible for more than two thirds of total value added. Moreover, with technology improving tradability and expanding the array of available products, services are increasingly traded across borders. Between 2010 and 2019, the overall export of services of OECD countries has indeed grown by more than 40%. Understanding where and how services are supplied to foreign customers is therefore crucial for addressing a variety of trade and economic policy issues. Such understanding, however, is difficult to obtain directly from readily available macroeconomic statistics. This is because services are traded through various and often complementary channels. Following a nomenclature introduced in the mid-1990s by the General Agreement on Trade in Services (GATS), services can be traded in four ways (‘Modes of Supply’): cross border supply (Mode 1), consumption abroad (Mode 2), commercial presence (Mode 3), and presence of natural persons (Mode 4). While many countries produce statistical information on at least some of these aspects of service trade, the information is generally scattered across

multiple sources (e.g. balance of payments, foreign affiliate statistics) that often use different definitions and classifications.
This paper describes ongoing work at the OECD to construct a coherent database to support the analysis of international trade in services by mode of supply. We build on the experience of two other ongoing long-term projects, the Inter-Country Input-Output (ICIO) tables and Analytical database on the Activities of Multi-National Enterprises (AMNE). The ICIO database is a time series of global multiregional input-output tables covering 77 economies and 45 industries over the period 1995-2020. The Analytical AMNE database expands the ICIO tables using foreign affiliates statistics, as well as other data sources, to identify the role played in each industry by multination firms.
Information on international trade in services by Modes 1 and 4 can be retrieved directly from the ICIO tables. Taken together, these are the transactions that give rise the international trade flows between countries that appear in the parts of the intermediate and final use matrices corresponding to service industries. As there are not enough data to support separate estimation of Mode 1 and Mode 4, at least in an initial stage the two are combined into a single aggregate. The ICIO tables also provide a natural estimate of trade in services by Mode 2, as the final demand matrix distinguishes expenditures of non-resident households from expenditures by residents. Finally, trade by Mode 3 is obtained from the Analytical AMNE database, which contains information on the output of foreign-owned firms. In fact, the Analytical AMNE data also allow us to separate the domestic sales of foreign affiliates from their exports, thus addressing the potential overlap with Modes 1 and 4 (exports of foreign affiliates that are Mode 3 from the point of view of the parent economy and Mode 1 or Mode 4 from the point of view of the host economy).
The resulting database has several desirable features. Firstly, it is an internally coherent dataset that has been adjusted for trade asymmetries and re-exports, is consistent with the national accounts and avoids all potential double counting issues. Secondly, it contains estimates of bilateral trade relations. In this respect, it complements the other existing source of data on service trade by mode of supply, the WTO's TiSMoS database. The TiSMoS database has indeed no breakdown by partner country, even though its country coverage is broader. Thirdly, our data align perfectly with OECD's ICIO tables and therefore allow for value-added analysis of trade in services.
After documenting the construction of the database, the paper will present the results of a preliminary analysis of trade in value added (TiVA) indicators by mode of supply.

Industrial relocation in a green hydrogen economy: a multiregional input-output analysis

Topic: Energy Policies
Author: Clara Rabelo CAIAFA
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Introduction
Industrial decarbonization will lead to a reconfiguration of global value chains (Egerer et al., 2024). As industrial production moves away from fossil fuels, higher transport costs for renewable energy sources (i.e. biomass, electricity and low-carbon hydrogen) will increasingly determine industry location decisions (Day, 2022). An emerging literature on this "renewables pull" effect (Samadi et al., 2023) points out that such "green relocation" would impact industrial production structures in different regions, through either relocation of existing production plants or changes in location patterns for new production capacities. Here, renewable energy rich countries with already strong mining sectors like Chile, Brazil, South Africa, and Australia would be in a

favourable position to attract such industries and promote green industrialization.

Research gap and aims of the study

As the green transition accelerates, understanding the potential of industrial relocation induced by renewables pull for promoting development in regions becomes ever more crucial. Nonetheless, the full economic impacts of such an industry relocation in different regions has remained an under-researched field. Studies have focused on how relocation of energy-intensive industries such as steel (Gielen et al., 2020) and ammonia (Egerer et al., 2024) could increase cost-effectiveness while contributing to achieve climate change mitigation goals. Since both "green steel" and "green ammonia" production would use low-carbon hydrogen as inputs, but would be easier to transport, studies have pointed out to opportunities for these activities to co-locate with renewables-based hydrogen production to overcome transport challenges (Arnaiz del Pozo & Cloete, 2022).

This paper analyses the potential economic impacts of a relocation of European industries to Brazil due to a new "green corridor" established between Brazil and the European Union via the Ports of Pecém (in Brazil) and the Port of Rotterdam (in the Netherlands). Green hydrogen hubs in Brazil are expected to provide one fourth of European green hydrogen imports and could lead to relocation of European industries to Brazil. The potential economic impacts in all world regions stem from additional investment in the green technologies (in Brazil), relocation (in the EU) and trade reallocation (all regions).

Methods

This is done in MRIO framework with 5 world regions (EU, Brazil, USMCA, India, China) where the relocation and the simultaneous establishment of green hydrogen are dealt with as change in the technical coefficient matrix of the MRIO system. Green technologies for steel and ammonia production are introduced as new technical coefficients in the domestic matrix and the column of technical coefficients in the steel and the chemical industry is the weighted sum (with output weights) of the old and the green technology. Relocation will also change the part of the technical coefficient matrix that describes inter-regional linkages. This is analysed in a type I and type II model version, integrating the MRIO price model. From this price model, cost and price effects of new green technologies and potential trade reallocation can be derived. The latter is derived by applying trade elasticities to the most important trade flows in this context. Prices therefore exert several impacts and feedback mechanisms on quantities in our approach. In a first step, the cost/price effects lead to multi-regional price-spillovers, which are in turn influenced by trade substitution effects. One main indicator for the cost and welfare effects of 'green industry relocation' is the aggregate consumer price index in the 5 regions. As the price and the quantity side are integrated, this consumer price effect exerts a feedback mechanism on consumption in all regions in terms of a real income effect.

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The impact of green policies on carbon inequalities in Italy: A macrosimulation approach

Topic: Special Session - Assessing Industrial, Trade and Green Transition Policies Through SFC-IO Models
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Climate change does not affect everyone in the same way, neither do the green transition policies envisaged to avert it. Consumption-based measures of greenhouse gas (GHG) emissions have allowed to deepen the understanding of carbon inequality, by tracing emissions along global supply chains (Davis & Caldeira, 2010) and identifying carbon footprints across income groups (Gore, 2021). For Europe, the integration of consumption and input-output data allows to estimate carbon inequality across countries, income groups, and categories of consumption goods (Ivanova & Wood, 2020), while carbon inequalities across sub-national regions is also of interest (Kilian et al., 2023). In this study, we follow the approach of integrating input-output matrices with household consumption patterns into a macrosimulation model, to analyze disparities in emissions from household consumption across subnational regions in Italy.

Italy exhibits some of the highest regional disparities among OECD countries in household income and unemployment (International Energy Agency, 2023). Regional differences are also prevalent for carbon emissions and energy consumption (Italy for Climate, 2022), with consumption-based emissions concentrated in Northern regions (Algieri et al., 2022), and big disparities in terms of energy poverty risk, renewable energy generation, and exposure to extreme climate events (International Energy Agency, 2023). Thus, climate change will deepen regional inequalities and affect disproportionally certain population groups in Italy, through its differentiated effects across regions, productive sectors, and income groups (Spano & Mereu, 2020). It is crucial to consider the distributional impact of green policies too, which can also deepen these inequalities (Vandeplas et al., 2022).

In this context, we assess how regional inequalities in Italy—in income and consumption-based emissions—will respond to different policies for the green transition: the elimination of carbon subsidies and a transition from fossil fuels to electricity. We use macrosimulations with a new version of the Eurogreen model for Italy (Cieplinski et al., 2021). Eurogreen is a data-driven ecological macroeconomic model based on a detailed input-output structure with demand-led growth, that allows to analyze simultaneously macroeconomic and environmental variables in a system dynamics framework. It includes a stochastic endogenous process of technical change, by which technical input-output coefficients and labor productivity change dynamically.

The new version of the model includes two novelties that allow for an analysis of households' income and carbon inequalities across regions. On the one hand, the model features 100 representative households, differentiated by region and income quintiles, which exhibit different income source compositions and consumption patterns. On the other hand, the model includes an integration between monetary and physical-energy input-output matrices, which provides a link between energy sources, productive structure, and emissions. Moreover, the new version expands the sectoral classification, providing a more detailed structure with regards to the energy sectors. The model is calibrated for 2010 as the base year, using data from Bank of Italy's Survey of Household Income and Wealth (SHIW), Istat's Survey on Household Budgets (SHB), and

Italian National Accounts for the household module, and from the World Input Output Database (WIOD) and EXIOBASE for the technology and energy modules.

In this framework, we simulate, on the one hand, the elimination of subsidies to fossil fuel industries, and on the other hand, a gradual transformation of the energy mix from fossil fuels towards electricity, first assuming only changes in the productive structure, and then allowing also changes in transport consumption patterns—from private vehicles to public transport. We find that the elimination of brown subsidies has a small effect on both income and carbon inequality—since it impacts sectors with different wage structures like agriculture, petroleum, and manufacturing. Regarding electrification, changes in consumption patterns make a difference. Without them, electrification reduces carbon inequality across income groups, as the impact on richer households' is stronger. On the other hand, changing consumption patterns increases regional households' carbon inequality, since the substitution towards low-emissions public transport is stronger in poorer regions, assuming considerable infrastructure improvements. In summary, our results highlight the strong connection between carbon and income inequalities, and how current inequalities condition the distributional impacts of green policies.

Optimal temporal distribution of supply multipliers for final demand forecasting: Argentina 2004-2023.

Topic: Input-Output Theory and Methodology
Author: Santiago CAPOBIANCO

The aim of this paper is to explore the possibility of bringing a temporal dimension to input-output multipliers. In particular, we are interested in forecasting quarterly final demand components from a set of mothly series of sectoral value added. The Monthly Estimator of Economic Activity (EMAE) is one of the most important economic situation indicators provided by the National Institute of Statistics and Censuses (INDEC) of Argentina. It provides a leading forecast for economic activity, disaggregated into fifteen (15) sectors, and advances the evolution of quarterly national accounts.

The supply driven version of the input-output model has been a subject of debate. First presented by Ghosh (1958), it was deemed implausible by Oosterhaven (1988), and later vindicated as a price model by Dierzenbacher (1997). In our view, Ghosh's allocation model has a nice interpretation within the framework of the Labor Theory of Value (LTV). Value added can be understood as the amount of labor unfolded by the labor force in the production process (Marx 2015). This value product (in Marx's words) reappears later in the gross output of other industries, as an intermediate input. Then, given an input-output matrix, total output can be reconstructed from a vector of sectoral value added. And final demand can also be estimated from the former.

An input-output matrix was constructed using the Supply and Use Tables (SUT) for the year 2018, and latter aggregated to match the series of the EMAE. With this two elements, it is possible to forecast the evolution of final demand components (private consumption, public consumption, exports and investment) in a quarterly series ranging from the year 2004 to 2023, using Gosh's supply multipliers. In addition, these estimations are improved by constructing a time dimension, a quarterly distribution for the effects of the multipliers. Two alternatives are presented for doing so. First, we explore a Distributed Lag Model (DLM) with no restrictions over the coefficients. In second term, we demand that the supply multipliers are not to be modified by the coefficients of the regression, so all betas from the lags must sum to unity and be non negative. This transform the DLM model into a quadratic optimization problem. Both alternatives are implemented in levels (currency at constant prices) and in percentage variations, and

compared.

The results shows that final demand forecast can be greatly improved by considering the temporal distribution. Specially in the case of Argentina's (mostly agricultural) exports, when the creation of value added tends to be lagged from its commercialization. Moreover, this approach can be extended to other kinds of multipliers, like the demand driven input-output model.

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Socioeconomic Impacts of integrated sugarcane bioenergy and livestock production in São Paulo state - Brazil

Topic:
Author: Terezinha de Fátima CARDOSO

Decomposing the effective rate of protection in Brazil between 2005 and 2023: trade policy or technical change effects?

Topic:
Author: Marta Reis CASTILHO
Co-Authors: Patieene Alves PASSONI, Marcelo Resende TONON, Adriano DUARTE

The primary objective of this study is to comprehensively analyze the evolution of effective protection for Brazilian tradable goods over the years 2005, 2008, 2014, 2021, and 2023. This analysis involves the estimation of the effective tariff and a structural decomposition of it into its main components: nominal import tariffs, domestic inputs, and imported inputs in order to distinguish trade policy and technical change effects.

As conceptualized by Corden (1971), effective protection measures the protection applied to final goods, discounting the applied tariffs on inputs weighted by their significance in the final good's value (technical coefficients of the input-output model). This study employs a partial equilibrium analysis, utilizing information on the productive structure and considering changes in domestic value added in comparison to a counterfactual scenario of a free market. In fact, the Effective Protection of an Activity (EPA) is defined as the disparity between observed added value and the hypothetical added value in a tariff-free scenario for both the activity and its inputs. This difference is presented as the percentage variation in protected domestic value-added, influenced by tariffs on the final good and imported inputs.

The proposed decomposition categorizes effective protection into three components: the impact of changes in nominal tariffs on imported goods, domestic inputs, and imported inputs. Given that tariffs affect the direct import of the product and its inputs in national production chains, a

specialized treatment is necessary. The Bennet method, suggested by de Boer and Rodrigues (2020), is employed for this purpose.

Calculation of EPA requires two essential pieces of information: the nominal tariff protection structure provided by the Secretariat of Foreign Trade (SECEX) of the Brazilian Ministry of Development, Industry, and Commerce and the production structure obtained from national Input-Output Tables (IOT). As official MIPs are released by the Brazilian Institute of Geography and Statistics (IBGE) at five-year intervals ending in zero and five, this study uses IOT estimates by Alves-Passoni and Freitas (2020) for non-corresponding years.

The novelty of this study lies in its methodology, which unravels the changes in effective protection. Unlike previous studies that calculate effective protection without identifying the key elements explaining the change, this research aims to fill this gap.

Preliminary findings reveal a decline in effective protective tariffs over time, primarily attributable to nominal tariffs. However, domestic and imported technical coefficient changes exhibit opposite trends, generally contributing positively to increased effective protection. Notably, despite imported inputs constituting 30% of total inputs in the Brazilian economy, they play an equal or greater role in decreasing effective protection compared to domestic inputs. This may be attributed to an increase in the relative price of imported inputs in the Brazilian production process and an augmented dependence on these inputs.

The UN-ECLAC MRIO tables of Latin America and the Caribbean: latest progress

Topic: Global Input-Output Accounts (GIANT): a collective initiative to harmonise input data entering ICIO tables published by international organisations (I)
Author: Sebastian CASTRESANA
Co-Authors: JOSE ELIAS DURAN

The United Nations Economic Commission for Latin America and the Caribbean will present the latest improvements of the Latin American Input-Output Tables 2018.

When Wassily met Raúl: The IO approach in structural analysis

Topic: Industrial policies
Author: Sebastian CASTRESANA
Co-Authors: JOSE ELIAS DURAN, Matthew GOMIES, Keiji INOUE

Raúl Prebisch’s proposals regarding strengthening regional integration are more relevant than ever in the Latin American region considering the reprimarization of the export basket and the accompanying de-industrialization. In addition, the international context calls for more resilience in some key sectors where the region has either a comparative advantage or the potential to further advance in global and regional value chains. This paper will analyze how an input-output analysis can help us identify key and driving sectors that have the potential to reinforce regional integration and sustainable development utilizing ECLAC’s Latin American and Caribbean RIOT. In addition, this aims at enlightening policy makers on how to increase interdependence within the region.

Sectoral identification was carried out using an algorithm that combines three complementary criteria: Identification of the degree of forward and backward linkages; export capacity, and the presence of production sharing in intra-regional trade. Formally, Leontief and Gosh multipliers are calculated simultaneously as measures of cluster existence; the propensity to export, as evidence of the existence of domestic supply available for intra-regional destinations; and a production share coefficient, defined as the intraregional value-added included in net exports. The results of these three indicators made it possible to obtain a ranking of the sectors with the largest value chains in the intraregional market circuit. With the sectors identified, the direct and indirect employment associated with intraregional exports was calculated.

As part of the ranking of identified sectors, the mapping of the interrelationships between the main linked sectors is carried out, mainly considering the three main ones and the entire interregional chain of their productive network for each of the selected sectors by country. The results and graphs are presented in an annex. The algorithm used for the selection of sectors was carried out in Python and was automated in an iterative dashboard complemented in Power BI.

Based on the ECLAC multiregional input-output matrix of Latin America and the Caribbean, the analysis and selection of clusters was carried out for 20 countries in Latin America and the Caribbean, mainly identifying the clusters of manufacturing sectors, classifying key sectors from the independent ones using the Rasmussen-Hirschman indexes. The three sectors with the highest presence of clusters identified were: automotive, agroindustry, and chemical and petrochemical. The Automotive and auto parts sector ranked first, with 20% of the region´s manufacturing total exports, and the agroindustry sector came in third, with 13%, and chemical and petrochemical, added another 7.6% to total exports. Taken together, the three sectors represented 40% of total exports and generated 28% of direct and indirect export employment linked to the region's exports (nearly 11 million jobs). At the country level, the intensity of employment associated with exports was higher in Argentina (56%); Colombia (37%); Brazil (31%), and Mexico (27%). The feasibility of increasing exports of these sectors will depend on the requirements of upgrading of skills and of additional investment.

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Mexico and China’s international trade structural decomposition analysis. 1995-2020

Topic: Input Output Analysis and policies
Author: Rosario CERVANTES

Given the similarities between Mexico and China’s access to world markets at the end of the 20th and the beginning and 21st centuries, in this paper, we explore some reasons for the differences in their economic performance over more than two decades. Using OECD inter-country input-output tables and structural decomposition analysis, we provide evidence highlighting how the Mexican economy was left behind in its Global Manufacturing Activities and the rest of the economy by 1) higher imported intermediate inputs coefficients and 2) lower diversification processes in the production of final and intermediate goods and services.

The Role of Energy Transition in Advancing Employment-Related Sustainable Development Goals

Topic: Energy policies
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The energy transition process is expected to result in job losses in the fossil fuel energy sector while fostering employment growth in the renewable energy sector. These anticipated outcomes have far-reaching implications that extend beyond the energy industry, reaching into the upstream supply chains. Previous studies, however, have primarily focused on assessing the direct impacts of energy transition within the energy sector and often only categorizing employment based on race, gender, and skill levels. Consequently, there remains a gap in our understanding of how the energy transition may affect the broader spectrum of employment-related Sustainable Development Goals (SDGs). In this paper, we employ a global multiregional input-output model (MRIO) to examine the multifaceted impacts of the energy transition on employment-related SDGs. First, we construct satellite accounts that delineate employment characteristics by gender, age, skill levels, formality (formal or informal), and safety (occupational injuries) based on data from the International Labour Organization (ILO). Then, utilizing the EXIOBASE MRIO tables, we comprehensively evaluate the energy transition's impact on various employment-related SDGs spanning the years 2004 to 2019. Overall, our analysis represents the inaugural global-level comprehensive assessment of this pivotal subject, contributing to deepening our understanding of the intricate interplay between energy transition and employment-related SDGs. Additionally, the employment satellite accounts developed in this study make a valuable database contribution to MRIO-based employment analysis.

The Impact of Productivity on Welfare of Nations through Global Value Chains

Topic: Input-Output Analysis
Author: Wenyin CHENG
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Total Factor Productivity (TFP) growth has long been recognized as a pivotal driver of welfare expansion. However, the precise impact of global TFP growth on national welfare growth remains

poorly understood both theoretically and empirically. To bridge this gap, we developed a simple yet potent model for the TFP-welfare analysis. We measure the gap between GDP growth and welfare growth of a nation, and further elucidate how this disparity, i.e. terms of trade (TOT) effect, is influenced by global TFP growth by integrating the concept of global value chain (GVC) TFP into the growth accounting framework. With the growing geopolitical instability and the restructuring of GVCs in recent years, including the shift from globalization to "slowbalization", the welfare effects from other countries' TFP growth have gained increasing significance in shaping the trade and technology policies.

Our contribution to the literature is manifold and can be delineated in three primary aspects. Firstly, we delve into the effects of global total factor productivity (TFP) growth on national welfare, a topic that has traditionally been explored through the lens of domestic TFP growth's contribution to national welfare, as highlighted by works such as Basu et al. (2022). These studies explore the welfare implications of TFP by employing the concept of revenue TFP instead of the conventional measure of physical TFP. However, they do not account for the nuances of international production fragmentation. While Kleinman et al. (2023) attempt to quantify the impact of both domestic and foreign TFP growth on national welfare growth. However, their approach, rooted in quantitative trade models, does not adequately capture the complexities of production networks due to the assumption that elasticities of substitution across different country origins are uniform. This overlook simplifies the intricate dynamics of global production and its influence on national welfare.

Secondly, unlike quantitative trade models, our model streamlines the assumptions and parameters needed, facilitating the comprehensive integration of production networks. Our model is grounded in growth accounting, thereby necessitating minimal assumptions and foregoing the need for parameters. For example, our approach obviates the need to estimate parameters critical to quantitative trade models, such as the elasticity of substitution. Estimating this parameter typically relies on stringent assumptions, which faces challenges in accounting for the heterogeneity across all countries and sectors. This issue persists despite trade economists' endeavors to estimate elasticities of substitution in detailed dimensions.

Thirdly, our research advances the understanding of the TOT effect by elucidating its origins in the TFP of individual countries. Prior investigations into TOT typically culminate in its quantification (Feenstra et al., 2015). Moreover, certain studies have utilized TOT as an explanatory factor for TFP growth. Contrary to these perspectives, our findings reveal that the causal relationship is inverted; it is TFP that influences TOT, not the other way around. This insight reshapes our understanding of the dynamic interplay between TOT and global TFP growth.

Through the application of our model to the World Input-Output Database, we have uncovered some novel findings. Our estimated TOT effect exhibits substantial similarity to the TOT effect calculated using the Penn World Table. We present the results of selected countries: U.S., Japan, Germany, China, India, as well as the rest of the world, including the welfare growth, components of TOT, country origins of TOT, direct and indirect TOT, and provide policy suggestions on promoting welfare growth. This approach affords us valuable insights into the intricate interplay between global productivity and national welfare growth.

Regional non-survey input-output multipliers: do regional data adjustments improve the household-endogenized model

Topic:
Author: Alena CHEPEL
Co-Authors: Andrey CHERNYAVSKIY

The paper adds to the literature devoted to constructing regional input-output multipliers.
Although non-survey input-output model is widely used in regional economic analysis (including due to its simplicity, good interpretability of results, low data requirements), a relevant issue is the compliance of the results with hypothetical (ideal) estimates. To make the estimates more realistic, it is preferable to maximize the use of additional regional statistical data in the calculations.
There are a number of methodological problems within the use of regional multipliers. The accuracy of calculations can be affected by the heterogeneity of production at the national and regional levels. Income generated by households in the region may be spent in other regions. For example, construction investment projects may attract workers from other regions, and their labor income may partially finance consumption in these regions. For some cases this factor may potentially be pretty significant:the share of labor migrants in regional employment can achieve 20% for some regions, according to the official statistics. However, induced effects estimation implies that we estimate consumption generated by labor income in the same region. Interregional differences in the propensity to consume can also have an impact on the size of the induced effects, determining the extent to which the increase in labor income is transformed into consumption. The variation of propensity to consume among regions is quite large, according to the statistical data, which suggests it could be an important source of making calculated multipliers more realistic.
We implement the location quotients technique to construct regional simple and total input-output multipliers for several Russian regions with various economic structures. Total multipliers calculations are modified by using regional factors adjustments: propensity to consume, contribution of labor migration to the formation of household expenditures, and household expenditures structure. Econometric tools were used to separately assess the effects of the factors under consideration. We used national input-ouput tables 2016 and regional data provided by Rosstat.
The results show that the full multipliers values are mostly affected by the propensity to consume and the factor of labor migration, and the least influenced by the structure of consumer spending in the region. We can conclude that such adjustments could be to some extent helpful in case of regions with high share of labor migrants in regional employment, as well as in case of regions with well-developed tourism industry, allowing to get more accurate induced effects estimates. The adjustments have the greatest effect for the industries of the budget sector (education, health care), characterized by a high share of the wage in the output, as well as construction. So, it could be reasonable to introduce forementioned adjustments into the analysis of total of changes in final demand in the budget sector or construction. However, for regions with insignificant impact of labor migration and tourism factors the use of the proposed adjustments on the value of regional total multiplier effects is insignificant.

Analyzing Critical Minerals Value Chains using the GTAP MRIO Data Base

Topic: Special Session: Supply chain on critical raw materials
Author: Maksym G. CHEPELIEV

Climate mitigation is widely recognized as one of the key transformational challenges faced by humanity (Ripple et al. 2020). Acknowledging the need for more ambitious policies, in recent years many countries have increased the stringency of their mitigation pledges. While in their original contributions, only several countries, such as Costa Rica, Bhutan and Sweden, announced net zero greenhouse gas (GHG) emission targets (Höhne et al., 2021), as of 2023, a total of 79 countries have communicated net zero goals in either policy documents (52 countries) or laws (27 countries) (Energy & Climate Intelligence Unit, 2023).

Earlier studies have estimated that achieving ambitious climate mitigation targets will require and unprecedented expansion in renewable infrastructure and technologies, such as wind turbines, solar panels, batteries for electric vehicles, etc. (e.g. Gielen et al., 2019). While such a transition is expected to substantially reduce the demand for fossil fuels resulting in stranded fossil fuel assets (Mercure et al., 2018), it would also lead to the growing demand for critical minerals, such as nickel, platinum group metals, zinc, rare earths, etc., which are essential inputs for the development of renewable energy systems (Tokimatsu et al., 2018). It is estimated that within the pathways toward limiting global warming below 1.5oC, the demand for critical minerals could increase between 2 and 267 times by 2050 depending on the mineral (Wang et al., 2022). Apart from pure supply and logistical constraints, the rising demand for critical minerals is also associated with national security aspects and is prone to generate geopolitical frictions (Vakulchuk et al., 2022).

In this regard, it is important to have the analytical capacity for the analysis of future energy transition scenarios with an explicit representation of the critical minerals value chains. At the same time, such a level of detail is missing in most global economic databases and models, including the Global Trade Analysis Project (GTAP) Multi-Region Input-Output (MRIO) Data Base (Aguiar et al., 2023), which underlies literally all global computable general equilibrium models and is widely utilized for the assessment of the socio-economic impacts of the climate mitigation policies (e.g. Böhringer et al., 2021; Chepeliev et al., 2021).

In this paper, we focus on enhancing the GTAP Data Base with additional sectoral details representing the critical minerals and selected downstream sectors. As suggested by the literature review, the group of critical minerals is highly diverse, but their mining and process is often concentrated in selected countries. We focus on the key critical minerals produced in the world in 2021 (ranking is implemented based on the value of global output). To estimate the value of the output of each critical mineral, a combination of the U. S. Geological Survey (USGS) data for quantities of output, as well as UN COMTRADE and London Metal Exchange estimates of commodity prices were used. For the case of Platinum Group Metals and Rare Earth Elements, it was first split into six elements: Platinum, Palladium, Rhodium, Osmium, Iridium, and Ruthenium, and then each commodity was evaluated separately before combining them back into a composite group.

Based on the implemented review of the key critical minerals and their downstream uses, we identify the most important commodities that will be disaggregated in the GTAP Data Base. We consider introducing up to 12 key critical minerals in the GTAP Data Base, as well as several downstream sectors, such as solar panels, wind turbines and batteries (differentiated by type). Corresponding sectoral splits are implemented to the latest version of the GTAP 11 Data Base with the 2017 reference year (Aguiar et al., 2023) and nest the additionally introduced sectoral details with the GTAP Circular Economy (GTAP-CE Data Base) (Chepeliev et al., 2022) implementing sectoral details using the SPLITCOM utility (Horridge, 2008). In such a way we

benefit from the previous efforts aimed at representing additional sectoral details relevant to climate mitigation and circular economy policies, which have already disaggregated several relevant sectors in the GTAP-Power Data Base, including aluminum, steel, copper, plastics and cement (Chepeliev et al., 2022).
Using the extended GTAP MRIO Data Base we provide a detailed analysis of the global value chains (GVC) of the critical minerals, estimating GVC participation and concentration metrics across countries and commodities. Such estimates would allow to better understand the configuration of these complex value chains and provide important policy insights in the context of import dependency and national security dimensions as the world continues to address climate mitigation challenges.

Azerbaijan: Pathways for Decarbonization in a Global Context

Topic: Input-Output Analysis
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As economies around the world are increasing their mitigation ambitions, Azerbaijan's lingering dependency on fossil fuel exports threatens its medium- and long-term economic development prospects. Global decarbonization is expected to directly impact the country's resource rents through lower fossil fuel demand and prices. With an increasing level of mitigation efforts both domestically and worldwide, it is important to understand what could be the implications of these actions on the economy of Azerbaijan, including producers, consumers and government, and what proactive policy solutions can a country implement to reduce emissions, increase competitiveness and boost the economy.

To answer these questions, we apply a comprehensive modeling framework that relies on a global computable general equilibrium (CGE) model coupled to a Global Trade Analysis Project (GTAP) multi-region input-output (MRIO) database. This framework is used to assess a set of exploratory scenarios that represent alternative futures under varying assumptions in terms of mitigation efforts. The set of policies and measures includes fossil-fuel subsidy reform, carbon pricing, and alternative revenue recycling options. The framework allows us to assess the implications of the policy options on a wide range of indicators, taking into account mitigation co-benefits, thus contributing to the ongoing discussion of future climate policy solutions for Azerbaijan.

Several important policy insights follow from our analysis. First, while being exposed to the declining global fossil fuel demand and prices that are expected to accompany decarbonization efforts in countries around the world, it is in Azerbaijan's self-interest to implement domestic mitigation policies. The latter would allow the country to benefit from the first-mover advantages by exporting fossil fuels at a relatively high price to the rest of the world. Our findings align with policy suggestions outlined in Vidadili et al. (2017), implying that the development of renewable energy in Azerbaijan could sustain fossil fuel exports. While Mukhtarov et al. (2020) find that high oil prices could be an obstacle to Azerbaijan's decarbonization efforts, our results suggest that they could also present an opportunity if the country moves fast on the decarbonization path.
Second, electricity and natural gas tariffs are currently well below their economic costs, due to the presence of implicit subsidies. Considering the current energy sector revenues windfall, the country is well-positioned to proceed with the subsidies' phase-out, as international experience shows that successful pricing reforms are often implemented when fiscal pressures are low (World Bank, 2023d). A gradual but steady phaseout of fossil-fuel subsidies by 2030, followed by

the introduction of economywide carbon pricing of at least US$25 per tCO2 by 2035 with the collected revenue being used to reduce factor taxes in Azerbaijan, is the economically most efficient path to incentivize clean energy transition and improve energy efficiency. From the policy perspective, such a transition entails a gradual deregulation of natural gas, electricity, and fuel prices, as well as a strengthening of regulators and market mechanisms in price setting – areas, where Azerbaijan has achieved limited progress in recent years (Cholewa et al., 2021; Guliyev, 2024).
Third, our results suggest that it is important to take into account broader environmental impacts and co-benefits from decarbonization efforts, such as reductions in air pollutant emissions, which further lead to improved air quality and declining mortality. When properly accounted for, such co-benefits could substantially reduce the overall cost of mitigation and even result in net welfare gains in Azerbaijan.

The Case Against Demographic Data in Input-Output Driven Economic Impact Analysis

Topic: Employment Policies
Author: Candi CLOUSE
Co-Authors: Bjorn MARKESON

Research Question
Satellite accounts are widely utilized in conjunction with EIA to examine effects on non-monetary changes per a certain level of industry output (Miller & Blair, 2022; ten Raa, 2017). Most often, employment (and sometimes unemployment) is added to models to show the jobs associated with a certain level of output (Batey & Madden, 1983; Batey, 1985; IMPLAN Group, LLC 2023). There is inherent danger in adding certain satellite accounts to an EIA. This concern arises when demographic data including age, gender, race, socioeconomic status, and other descriptive data points are linked. Data included in these models is based on collected data on the arrangement of the economy in a given time period. While EIA models use data that describes an economy for a certain year, making assumptions about how this carries forward and prescribing outcomes for demographic variables is dangerous territory. Not only is the data volatile over the short term, discrimination in the workforce is still prevalent. This paper argues that demographic data should never be utilized as a satellite account for economic impact analysis. While results stemming from these studies are unlikely to be vetted, it is extremely unlikely that the new employment stemming from an analysis would mirror the latest demographic dataset.

Methodology & Data
To analyze the discrepancies between descriptive demographic data and actual employment a sample of five universities in various locations across the United States. Information was gathered from each university’s website outlining the most recent gender and racial breakdown of their faculty and staff. The data from these universities was compared to data on gender and race from the U.S. Bureau of Labor Statistics and the composition of the Metropolitan Statistical Area (IMPLAN Group LLC, 2023; U.S. Bureau of Labor Statistics, 2022). An economic impact analysis was analyzed hypothesizing what an additional 100 jobs would look like for each university.

Discussion & Novelty of Research
Demographic data shifts drastically over time by data point and region. The case can be made for examining one or two demographic variables within an economic impact analysis like employed versus unemployed or urban versus rural, the generalized usage of pairing swaths of this data within these models is nothing short of terrifying. A recent report on transit infrastructure

examined potential investments in a transit system which details the economic, workforce, environmental, and equity impacts (KPMG, 2021). Utilizing the Socioeconomic Indicators Module from REMI, they detail three potential investment scenarios (REMI, 2021). Some valuable and defendable information is highlighted like how a significant financial investment could drop the unemployment rate by 0.03% (KPMG, 2021). However, the majority of the equity impact focuses on statements including “80% of employment gains to benefit workers in the lowest two income quintiles,” “Among minority groups, Hispanics benefit from over 20% of the total jobs gained,” and “An average of 35% of employment gains to benefit Black workers, with more gains in the operations phase” (KPMG, 2021).

While it is unlikely that results presented from an equity perspective would be checked for accuracy, the persistent brand of discrimination calls for research that advises with the best data and the best intentions for informed decision making. Inferences about potential impacts on output, employment, occupations, and environmental effects seek to enlighten. Inferences that sit on unreliable data and add discrimination on top, are taking the science of economic impact analysis too far in their claims. As economic impact is considered both a science and an art, researchers should endeavor to utilize the models appropriately while realizing their inherent limitations, and in this case rely more on the science and less on the art.

Comparing the macroeconomic demand-side v supply-side impacts of offshore renewable energy

Topic: Input-Output Analysis
Author: Kevin CONNOLLY

Comparing the macroeconomic demand-side v supply-side impacts of offshore renewable energy

In this paper, we analyse and compare the demand and supply-side macroeconomic impacts arising from investment in offshore wind, using Northern Ireland as a case study. A wide range of studies currently exist in which researchers analyse the impacts of offshore renewable energy investment, with many of these studies focusing solely on the economic activity arising from the construction and operation of offshore renewables. However, recent research has revealed that investment in offshore wind has a positive impact on electricity prices (compared to the business-as-usual case), resulting in lower consumer prices. Fundamentally, this is driven by increased energy security, with offshore wind replacing fossil fuel generation in the electricity mix, thereby reducing reliance on natural gas and coal imports, which are subject to significant price variation depending on geopolitical situations, as seen in 2022 with the onset of the Ukraine-Russia conflict. Nearly all industries across an economy use electricity in some form or another, so any decrease in wholesale electricity prices should lead to lower production costs, driving economic activity. Also, as offshore wind farms have an expected lifetime of around 25 years, the economic impacts from the lower electricity prices are much longer-term than those of the development and construction stages of offshore wind (usually around 5-6 years).

The main research question is to analyse the scale of the economic impacts resulting from the change in electricity prices compared to that of the construction and operation of offshore wind. A key objective of the paper is to help policymakers understand the mechanism by which offshore wind can drive economic activity in many industries, taking into account both supply-side impacts and traditional demand-side factors.
Many of the previous studies analysing offshore wind either use Input-Output (IO) or Computable General Equilibrium (CGE) models. For this paper, a CGE framework is applied. A purpose-built

CGE model, calibrated to 2018 with 30 industrial sectors for Northern Ireland, was developed to analyse the economic and environmental impacts of the energy transition, which is a key part of the nation's recently published energy strategy (DfE, 2021). The model was based on the AMOS (A Model of Scotland) CGE framework.

Using this framework, two core scenarios are modelled – first, a standard appraisal of the impacts arising from investment in building and running offshore wind farms in Northern Ireland, and second, an evaluation of the impacts arising from lower electricity prices compared with the BAU case. Currently, there are no offshore wind farms in Northern Ireland. However, through discussions with policymakers and industry, we estimate that 2GW will be needed by 2040 if the country is to reach its net-zero carbon targets. Cost estimates are based on a generic fixed foundation offshore wind farm in the UK, provided by the Offshore Renewable Energy Catapult (ORE, 2023). Key to economic appraisal is the amount of local content, and for this, we use information from our previous work on the offshore wind supply chain in Northern Ireland (FAI, 2023). The supply-side estimates are based on recent work by Hosius et al (2023), who estimate the pricing impacts of 1GW of wind across different regions of Northern Europe.

Overall, we find that there is a significant difference in the economy-wide demand and supply-side impacts related to investment in offshore wind, with a 4.6 and 2.9 times increase in GVA and employment, respectively, over a 60-year period. This is an important issue presented to policymakers, as the focus is often on the 'green jobs' related to the construction and operation of renewable technology, but we have shown that the economic impact is severely underestimated if pricing impacts are not accounted for.

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The input-output approach in rural electrification assessments: a review of experiences and challenges

Topic: Energy policies
Author: Jordi CRAVIOTO

Input-output analysis is a powerful tool for studying complex economic structures, their interdependencies and environmental impacts. Input-output analysis, pioneered by Nobel laureate Wassily Leontief in the 1930s, revolutionised economic analysis by providing a systematic framework to understand inter-industry relationships. The method rapidly became a cornerstone of economic planning and policy analysis in the 1950s. By the 1960s, input-output analysis had already spread globally, guiding economic planning in various countries. Its application subsequently expanded beyond industrial interdependencies to include regional and

social dimensions. Scholars have refined the method, incorporating dynamic elements, addressing sectoral complexities, and applying it to other fields. Miller (2021) provides a comprehensive overview of the latest developments, including the construction and application of multiregional and interregional models, the application of these models to global economic issues such as climate change and international trade, and their use in energy and environmental studies. These developments have significant implications for various fields, including economics, regional science, urban planning, and public policy analysis.

Within energy studies, the input-output approach could be a powerful tool for studying the multiple and complex effects of rural electrification projects. More than 775 million people still live without electricity, and recent reports suggest that such a figure has increased for the first time in decades (IAE, 2022). The input-output approach could be instrumental in identifying key sectors directly and indirectly affected by rural electrification, such as agriculture, manufacturing, and services sectors, which may experience changes in production and income due to improved access to electricity. It could assist in quantifying changes in output, income, and employment across economic activities due to rural electrification, including not only the sectors directly involved in electricity generation but also those that benefit indirectly from increased economic activity, or assist in the assessment of how income is distributed among different sectors and households, allowing policymakers to identify potential equity issues and design targeted interventions. Moreover, input-output analysis could be extended to assess the environmental impact of rural electrification by examining the resource use and emissions associated with increased economic activities. Therefore, policymakers could use input-output analysis to evaluate the potential effects of different policy scenarios related to rural electrification, assisting them in making informed decisions about investment priorities, subsidy programs, and regulatory frameworks.

However, several challenges and difficulties are still associated with applying input-output methodologies in rural electrification analysis. In this study, we aim to analyse the existing applications of input-output methods on rural electrification projects, the challenges and the difficulties associated with its applications in such contexts, and to discuss how alternative approaches, such as qualitative methods, can help address some of these challenges. Based on a review of recent articles related to the application of input-output methodologies in the study of rural electrification, we will analyse the scope of the applications and their challenges to discuss the areas of opportunity and limitations of their application in the local context. Preliminary results suggest that the availability of detailed and accurate data for rural areas, especially in developing countries, is one of the main challenges. Obtaining such data for rural regions may be limited or incomplete. Rural economies frequently include a substantial informal sector, which may not be well-documented or included in official statistics, leading to an incomplete representation of the economic activities in rural areas. Other challenges include how rural electrification impacts can vary significantly across different regions or how to adapt these models to incorporate dynamic changes over time or behavioural changes. Finally, our study will discuss whether integrating qualitative data could create a more holistic and context-specific understanding of the complexities associated with rural electrification.

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PRODUCTIVITY AND DEMOGRAPHIC TRANSITION: LIMITS TO THE BRAZILIAN ECONOMY'S RECOVERY IN THE POST-PANDEMIC PERIOD

Topic: YSI and Development Programme III (Discussant: G. Hewings and D. Meade)
Author: bruno wroblevski DA ROCHA
Co-Authors: Kenia B. DE SOUZA

In recent decades, studies show that changes in the demographic structure can impact its economic growth and development through different mechanisms (FOUGERE; HARVEY, 2007; BLOOM et al., 2010; FERREIRA; SANTOS, 2020). This phenomenon, known as demographic transition raises various discussions in the literature - such as its impacts on social security and public finances, consumption patterns, demand for public health and education, and in the labor market, as it directly influences labor availability. In this context, studies specifically focused on the labor market, such as Peng (2008), Pappas and Nikos (2008), Maestas et al. (2016), Liu and McKibbin (2022), and Zuo et al. (2022) suggest that, in the context of population transformations, one of the important channels impacting and limiting economic growth occurs through labor supply constraints.

The relationship between demographic change and labor supply is a recurring theme in the literature. While a reduction in the workforce poses a constraint to economic growth, one of the channels for sustainability and income increase is to increase labor productivity (FOUGERE; HARVEY, 2006; PENG, 2008; AMARANTE; COLACCE; MANZI, 2021; LIU; MCKIBBIN, 2022; ZUO et al., 2022). This is because young and elderly age groups, considered 'dependent,' may consume more resources than contribute through their work. Therefore, increasing labor productivity has the capacity to minimize the negative impact of labor supply constraints (MASON; LEE 2022). This discussion is particularly relevant in Brazil, which historically has been characterized as a low labor productivity compared to other peer countries.

The above motivates this research, which aims to assess the growth of the Brazilian economy in the post-COVID-19 period, considering the projections of labor supply constraints based on the demographic projections for Brazil. We use a dynamic inter-regional Computable General Equilibrium (CGE) model called TERM-UF. The dataset employed is the Brazilian Input-Output Database (release 2015).

We aim to contribute to accounting literature in the following ways: (1) First, we use detailed regional model, focused on Brazilian Federal Units. According to Fougere and Harvey (2006) and Poot (2008), regional age structure changes can be faster and more diversified than those observed at the national level, consequently having a significantly differentiated impact on the competitiveness of that region and interdependent regions. (2) Second, through the analysis of general equilibrium, we can understand the effect of labor supply constraints from a broader perspective compared to a partial equilibrium study, as it considers the systemic effect resulting from the interactions and interdependencies of different sectors and agents in the economy, contributing to more comprehensive policy planning and development. (3) Finally, literature on this theme for developing countries is scarce, especially at the subnational level.

In sum, this paper answers not only if the reduction in the labor supply in the Brazilian economy leads to changes in aggregate and sectoral demand patterns but also explores if the pattern of demographic change across Brazilian regions can influence the economic outcomes across distinct regions. These are all significant issues for the development of the world and a country.

The results indicate that the reduction in the labor supply in the Brazilian economy leads to

changes in aggregate and sectoral demand patterns, resulting in lower economic growth, higher labor costs, and reduced overall economic production. The findings also reveal that the pattern of demographic change and structure is not homogenous among Brazilian regions. The states of Rio Grande do Sul, Minas Gerais, Bahia, Pernambuco, Sergipe, and Piauí were the states with the highest projected reduction in labor supply over the period, and consequently, with the highest cumulative negative deviation of their regional product by 2060, which could reach 10.11%. These findings revealed that to uphold a trajectory of economic growth, the country faces the inevitable challenge of altering its course from stagnant labor productivity.

Overcoming the trade-off between economic growth and CO2 emissions. Tools and policies with CGE model based on E-SAM

Topic: Energy policies
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As a member of the European Union, Italy is committed to respect the binding targets to contribute in reducing the total amount of greenhouse gas emissions by 55% within 2030 and achieving the net zero emissions balance by 2050.
Since the Italian-specific commitment involves the reduction of greenhouse gases from selected sectors (road transport, buildings, agriculture, waste management and non-energy industries) the National Recovery and Resilience Programme (PNRR) and the Integrated National Energy and Climate Plan (PNIEC) provided for comprehensive structural and sectoral reforms and investments aimed at achieving these objectives. Although considerable progresses have been made in terms of reducing greenhouse gas emissions, further efforts are required to meet the targets by 2030.
Indeed, energy and climate transition processes are an important challenge that will require significant investment and generate a significant tax impact. The transition will involve a large-scale shift in employment between sectors, requiring the Government to implement policies to facilitate this structural transformation and protect vulnerable households. In this context, the selection of the most appropriate environmental policy tool or set of tools requires an ex-ante evaluation of the potential disaggregate economic and environmental effects of each proposal.
In particular, the development of multisectoral general equilibrium models based on national and regional accounts responds to this exigency as they are able to delineate the functioning of economic systems in disaggregated terms and identify the transmission mechanisms of policy measures. Computable General Equilibrium (CGE) models calibrated on Social Accounting Matrices (SAM) are widely applied to support the policy maker decision process on different domains and they can be extended to the evaluation of the effectiveness of environmental policies since they can be extended to include the interactions between environmental and economic variables.
With this intent, in this paper an extension of MACGEM-IT (Multisector Applied Computable General Equilibrium Model for Italy) to include the environmental module is proposed, to provide the policy maker with an analysis instrument able to evaluate both the economic and environmental disaggregate, direct and indirect impacts of policy measures on the income circular flow.
The environmental extended MACGEM-IT model is a SAM based CGE model in which the environmental variables are assumed to be endogenous, thus related not only to the total amount of total production (or consumption) of goods, but also to the amount of abatement capital demanded by production processes to trigger the energy transition target. Indeed, the demand of abatement capital would drive to technological leap toward less polluting production processes. This can represent one of the channels to reduce the amount of CO2 emissions, and

consequently the amount of carbon taxes payed by activities. In other words, an effort is made to incorporate in the model the possibility for the production processes to substitute the polluting capacity, thus the costs associated to environmental taxes, with new capital able to abate the amount of emissions. In this perspective, the CO2 emissions would be positively affected by the total production and negatively affected by the amount of capital abatement employed in each production process, allowing to overcome the supposed trade-off between environment protection and economic growth.
Based on the SAM for Italy integrated with environmental flows (E-SAM), the environmental MACGEM-IT model will be implemented to assess the impacts of hypothetical scenarios of technological transition to greener processes coupled with environmental fiscal policies.

Are changes in US employment mostly driven by production technology or trade? A structural decomposition analysis

Topic: Structural Decomposition Analysis
Author: Hylke DIJKSTRA
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This paper quantifies how much trade structure changes and changes in production technology contribute to changes in US employment by using input-output (IO) and structural decomposition analysis (SDA). I use SDA to separate changes in employment into the contribution of its drivers (e.g. trade structure changes or changes in production technology). I combine IO tables from the World Input-Output Database (WIOD) with employment data for different skill types for the period 1995-2008 and different occupations for the period 1999-2007 in the empirical specification. First, I find that trade structure changes contribute to a 3.2 million (17.2%) decrease in US manufacturing employment, and a 2.3 million (2.0%) decrease in US non-manufacturing employment, totaling a 5.5 million (4.1%) decrease in US employment. Second, I find that changes in production technology contribute to a substantially larger 8.0 million (43.0%) decrease in US manufacturing employment, and a 26.8 million (23.2%) decrease in US non-manufacturing employment, totaling a 34.8 million (26.0%) decrease in US employment. Third, I provide renewed evidence for the skill- and routine-biased technological change hypotheses. That is, changes in production technology contribute to larger decreases in low-skilled and medium-skilled or routine employment compared to high-skilled or non-routine employment. These results are consistent with most of the literature which exploits econometric techniques and they suggest that policymakers should take the heterogeneous impact of trade structure changes and changes in production technology on US employment into account when developing policies that aim to curb the redistributive consequences of these changes.

GLOBAL VALUE CHAINS, TRADE AND EMPLOYMENT IN MERCOSUR: A STRUCTURAL DECOMPOSITION ANALYSIS

Topic: YSI and Development Programme III (Discussant: G. Hewings and D. Meade)
Author: Adriano DUARTE
Co-Authors: Marta Reis CASTILHO

(1) Research question: It is widely cataloged in the international trade literature that the globalization movement has imprinted - mainly from the 1980s onwards - an expansion of trade flows as rarely seen in the history of recent capitalism. However, since the 2008 crisis, there has been a slowdown in several indicators related to international trade. The 'era of

hyperglobalization' (as it is commonly referred to by international bodies) has faced an uncertain context, marked by the rise of trade protectionism, the emergence of the discussion about reshoring strategies, political discussions about the social and environmental effects of offshoring and the stagnation of the share of international trade in global production. Many factors are behind the dynamics of international trade in the last forty years. For our purpose in this work, we want to highlight the process of trade liberalization that operated through the strengthening of regional integration agreements. In particular, we aim to evaluate the developments in domestic employment generated from Mercosur trade in final and intermediate goods and services, considering the effects of the global scenario after the 2008 crisis (the 'slowbalization' period).

(2) The method: The empirical strategy adopted in our work dialogues with the literature that measures international trade in value-added and estimates trade flows based on multi-regional input-output matrices (MRIO). We performed two exercises. Firstly, we break down Mercosur employment based on the type of production, (i.e. according to their destination). In doing so, we will be discriminating Mercosur production aimed at domestic consumption and international trade, the latter separated into traditional trade (of final goods and services) and GVCs (intermediate goods and services). For our purposes, we further qualified the participation in international trade according to the bilateral flows carried out with five trading partners (in addition to the rest of the world). Then, using the structural decomposition method, we verified to what extent the evolution of employment in Mercosur is related to four factors: the effects of changes in labor productivity, participation in production chains (or economic upgrading), the inter-industry structure of the trade bloc, and with the changes in the final demand (domestic and foreign, considering the different commercial partners).

(3) The data: Our sample is composed of a group of 189 countries and 26 sectors. EORA26 MRIO provides information for different countries and their sectors regarding the flow of intermediate goods and services, and final demand (domestic and foreign) for different components, value-added, and products. In addition, we gathered employment data by country from the International Labor Organization (ILO).

(4) Novelty of research: We believe our efforts contribute to the literature in some ways. First, our study estimates the jobs created in Mercosur according to the production component, discriminating international trade in final and intermediate goods and services. Secondly (and a direct consequence of the first), our study goes deeper by considering the different trading partners in the many spheres of international trade. Thirdly, the structural decomposition sheds light on the role of a set of intra-bloc structural factors and final demand on the creation of jobs in Mercosur in a way that has not yet been estimated. Finally, we studied how the changes in the global context after 2008 influenced the results previously obtained.
Regarding the results obtained, we found that Mercosur employment related to international trade grew at a higher rate than those for domestic consumption in the pre-crisis period, driven mainly by foreign demand and a marginal effect of the inter-industry structure. After the 2008 crisis, the jobs created were those related to activities for domestic consumption, with a drastic reduction in the role of foreign demand and the adverse effects of the inter-industry structure on employment growth.

Economic effects of a trade agreement between China and the Latin American Integration Association (LAIA): analysis using a multi-sector and multi-country dynamic general equilibrium model

Topic: Trade and Global Value Chains Policies
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Co-Authors: Jesús Enrique MORALES

This study introduces a comprehensive Dynamic Stochastic General Equilibrium (DSGE) model designed to assess the potential impacts of a prospective trade agreement between China and the 11 member nations of the Latin American Integration Association (LAIA) (ALADI for its acronym in Spanish) over ten years. Integrating principles from both Computable General Equilibrium (CGE) literature and pioneering works such as those by Bouakez et al. (2014) and Pasten et al. (2020), the model extends existing methodologies by incorporating a detailed framework encompassing imports, exports, and various economic factors.

Drawing from Rotemberg's (1982) work on price rigidities and Christiano, Eichenbaum, and Evans' (2005) and Smets and Wouters' (2007) contributions to macroeconomic modeling, the model incorporates complex elements including consumption habits, investment adjustment costs, variable capital utilization, and endogenous capital depreciation. These improvements help us better understand the many different aspects of trade agreements.

The calibration process of the model relies on the Input-Output Matrix jointly compiled by the Asian Development Bank and the Economic Commission for Latin America and the Caribbean (ECLAC) for the year 2017. This dataset serves as a reliable foundation, accurately reflecting the trade and production landscapes of that period. Each of the 11 ALADI member countries is represented as a distinct regions within the model, with 14 sectors allocated to each, while China and the rest of the world are treated as single entities with 14 sectors each.

To simulate the effects of a potential trade agreement, we define two counterfactual scenarios. The first scenario assumes a complete elimination of bilateral tariffs between ALADI countries and China, while the second scenario considers reductions in tariffs based on existing trade agreements between China and select ALADI countries (Chile and Peru). Additionally, we explore the implications of potential reductions in non-tariff barriers in China and their impact on bilateral trade dynamics at both aggregate and sectoral levels.

The simulation results offer valuable insights into the potential economic consequences of different trade agreement scenarios. We find that under the scenario of complete tariff elimination, the projected impact on GDP ranges between 0.06% and 0.13% for the period 2021-2030, depending on the degree of market opening. However, this impact could be amplified to 0.17% if non-tariff barriers in China were also reduced.

Furthermore, if the opening aligns with the average tariff reductions observed in Chile and Peru, the overall impact on output for the entire LAIA region is estimated to be around 0.16%.

The novelty of the work presented is twofold: Firstly, it provides a detailed analysis of the potential economic effects of trade agreements, especially within the context of the LAIA region. We observe substantial increases in both exports and imports within LAIA, suggesting potential gains from enhanced trade integration. However, we also note a significant decline in bilateral trade balances with China, underscoring the importance of considering the broader impacts of trade agreements.

Secondly, our study represents a significant advancement in economic modeling by bridging the gap between DSGE and CGE methodologies. By integrating the robust structure of DSGE models with the detailed sectoral and regional analysis enabled by CGE models, we offer a comprehensive understanding of the potential economic ramifications of trade agreements.

In conclusion, our research highlights the complexity of assessing the economic impacts of trade agreements and stresses the need for careful consideration of various factors. By using a

sophisticated framework and exploring multiple scenarios, our study offers valuable insights for policymakers and people involved in international trade.

A premier (limited information) multi-regional input-output matrix for Argentina 2019

Topic: Regional Analysis
Author: Pedro ELOSEGUI
Co-Authors: Gabriel Nicolas MICHELENA

Multi-regional input-output (MRIO) matrices are an important tool for regional economic analysis, but compiling the data for them remains challenging, especially in developing countries like Argentina. There is no consistent, up-to-date, official national I-O table available for Argentina, and data at the provincial level is limited and fragmented across different sources. This paper makes a dual contribution: firstly, constructing the first MRIO table for Argentina in 2019 using official and customized sources, and secondly, evaluating I-O multipliers, providing insights for future applications. The MRIO table includes 5 regions aggregating the 24 Argentinean provinces and 20 economic sectors. While only basic multipliers are presented, the table provides a foundation for more in-depth input-output modeling and analysis of production, consumption, and trade linkages between regions and sectors in Argentina. We found a high concentration in the provinces of the Pampeana region in gross output, value added and regional internal inputs, although less in external inputs, confirming the asymmetric structure of the country. In addition, the analysis of multipliers allows us to detect some relevant links in the peripheral regions reflecting the interaction of spatial location and sector specialization.

The environmental-social-economic impacts of EU investments on African countries

Topic: Regional Analysis
Author: Jiajie FAN
Co-Authors: Ruoqi LI, Kailan TIAN, Hongzhi ZHANG, Jon OLDFIELD, Yuli SHAN

The European Union (EU) Global Gateway initiative plans to invest €150 billion in African regions after COP28, focusing on infrastructure, green and digital transitions, sustainable growth, job creation, health systems, and education. However, research question could be raised such as, what is the impact of a large sum of Foreign Direct Investment (FDI) on African economies, especially regarding the long-term structural change influenced by investment strategies. To answer this question, we examine the broad impacts of EU Global Gateway initiatives on African economies, societies, and environments. The uncertainty surrounding the impact of investments from global north to global south, spanning from economic, social, and environmental perspectives, necessitates a holistic assessment to aid the formulation of investment strategies.

This study uses our newly developed global multi-regional input-output model for emerging economies (EMERGING) to analyze the environmental-social-economic impacts of €150 billion investments across 59 African countries. The three impacts will be quantified by CO2 emissions, employment opportunities, and GDP, respectively. EMERGING provides MRIO table and satellite account for 245 countries and 134 sectors. Due to a lack of detailed investment plans at this moment, we developed 23 scenarios to distribute the investment across five key sectors, comprised of 134 sub-sectors, within each region. The reference scenario is designed based on

funding needs for climate projects in African countries, and the other alternative 22 scenarios have different investment strategy for detailed analysis of the impacts. Our study encompasses a two-stage impact quantification process, assessing both the immediate impact when investment is fully absorbed by sectors (stage 1) and the long-term impact of final consumption growth driven by economic growth once it has fully taken shape (stage 2).

Our results show that, the reference scenario demonstrates a positive impact, yet may not be benefit-optimal. The investment will bring an increase of 5.9% and 8.1% in value added and labor value respectively, together with 20% extra CO2 emissions upon the accomplishment of stage 1. At the national level, South Africa emerging as the major contributor to value-added increases (35%), albeit also accounting for the largest increment in CO2 emissions (72%). At the sector level, the Energy sector is responsible for the most significant rise in CO2 emissions (80%), but this does not correspond with commensurate gains in value-added (27%) or labor value (6%). In exploring strategic optimization, trade-off between economic advancement and climate impact is discussed, revealed by some alternative scenario such as reallocating 10% investment share from the Energy sector towards the Manufacturing sectors could effectively diminish CO2 emissions by 11% compared to the reference scenario, while boosting GDP and labor value by 5% and 11%, respectively. By comparing changes in indicators across two stages, it was observed that after all consumption driven by economic growth fully materialized, only the Service sector experienced an increase in the economic share (6.2% growth). Simultaneously, traditional high-emission sectors like Energy and Agriculture saw reductions in CO2 emissions (decreases of 2.3% and 1.7%, respectively). This indicates the investment's role in changing Africa's economic structure.

Investment may fall short in achieving an optimal balance between economic returns and sustainable development when shaped solely by the financial needs claimed by African regions. Investment strategy that only considering the financial requirement may not capitalize on the potential economic pull of relatively advanced regions. The study also uncovers the limitations of a strategy focused predominantly on sectors with low net-value and emissions. This approach, while seemingly advantageous in terms of emissions, overlooks the potential for more sustainable development outcomes through investments in infrastructure and enhanced technology transfer. A more holistic investment strategy, encompassing advanced technology and infrastructural development, could yield more sustainable and balanced growth by adjusting the economy structure.

The novelty of this research lies in its comprehensive assessment of the EU's investment impacts using a unique input-output model specifically tailored for African economies. Unlike previous studies, our research provides a detailed scenario-based analysis, offering insights into how strategic shifts in investment allocation can significantly influence the environmental, social, and economic outcomes. This study not only fills a critical gap in understanding the multifaceted impacts of large-scale foreign investments in Africa but also offers a pioneering approach in evaluating and strategizing sustainable investment in emerging economies.

Outsourcing and occupational structure: An Input-Output Perspective

Topic: Employment Policies
Author: Marta FANA
Co-Authors: Davide VILLANI, Ariel Luis WIRKIERMAN

There are growing concerns about the evolution of the employment structure and its integration with the sphere of production. Recent contributions have focused on the evolution of the occupational composition both between and within countries. Much of the debate revolves around the polarisation of the American labour market (Autor et al., 2003) that consists in the more rapid growth of occupations at the bottom and the top of the distribution, at the expenses of the middle (manual) occupations. Since then, several contributions have tried to assess whether polarisation applies to other economies, finding mixed evidence (Breemersch et al., 2019; Dwyer and Wright, 2019; Eurofound, 2014; Fernández-Macías, 2012; Fernández-Macías and Hurley, 2017, among others). Most of the differences in findings can be imputed to the methodology employed to record occupational rankings and to variations across countries.

So far, only few researchers linked changes in occupational structures to input-output analysis and global value chains. For example, Reijnders and de Vries (2018) test the Routine Biased Technical Change hypothesis matching input-output tables and occupational data for a large sample of countries. Timmer et al. (2019) study the functional specialisation in trade, intended as the flows of value added in particular groups of occupations and, similarly, Kruse et al. (2023) focus on the concentration of occupations in exports across thirty countries. These studies provide relevant insights about the international linkages in production. However, to the best of our knowledge, less attention has been paid to the domestic process of outsourcing which represents a growing phenomenon of our societies (Berlingieri, 2013; Lábaj and Majzlíková, 2022).

The present paper contributes to this strand of literature combining information on occupational structures with multi-regional input-output data for EU28 countries to study the process of domestic outsourcing in European countries. Occupational data are retrieved from the European Labour Force Survey which are then matched with the Inter-Country Input-Output (ICIO) tables by the OECD over the period 1995-2011.

We employ the notion of vertically integrated sectors (Pasinetti, 1973) to account for the domestic direct and indirect labour inputs (detailed at the occupational level) needed to produce the final output. This methodology makes possible to explore how the occupational structure within vertically integrated sectors has evolved across European countries, accounting for domestic outsourcing. A shift share analysis is applied to assess the extent to which dynamics are attributed to shifts in the occupational composition within each subsystem or changes in their size. Furthermore, we estimate the Occupational Revealed Comparative Advantage (ORCA) indicator to study the relative specialization of vertically integrated sectors across European countries.

One novelty of the paper is that we provide a more solid accounting of the evolution of occupations along the productive structure compared to conventional studies based on occupational changes at the industry level that do not capture the contribution of outsourced workers to the production of the final output. Using vertically integrated sectors, we are able to quantify for such phenomenon, providing a picture that is more consistent from a productive standpoint.

Overall, the paper aims at contributing to the literature on occupational structure an input-output analysis building a dataset for European countries. The findings provide new insights on the extent of the outsourcing process, from an innovative perspective compared to standard industry-based research.

Global tourism carbon footprint: toward decarbonisation

Topic:
Author: Futu FATURAY

The global tourism sector exhibited remarkable growth, with an annual increase of 5.5 percent from 2009 to 2019, which was twice as fast as the global GDP growth rate during the same period. This significant economic expansion in the tourism industry over recent decades has not come without an environmental cost. The tourism sector has emerged as a substantial contributor to global carbon emissions, accounting for approximately 8 percent of global emissions. As the global tourism sector now recovers and indeed thrives post-covid, the environmental footprint of tourism is expected to expand accordingly. In light of the global objective to achieve net-zero carbon emissions by 2050, there is an increasingly urgent need for continuous monitoring and comprehensive analysis of carbon emissions associated with tourism. This research aims to provide a meticulous examination of the carbon footprint left by global tourism. We employ the input-output framework to analyse not only the direct emissions resulting from tourism activities but also the indirect emissions generated through the supply chains and interdependencies of the tourism sector. Our comprehensive study spans over 150 countries and evaluates each country's progress in reducing carbon emissions within the tourism sector since 2009.

Circular economy innovations in a 2-area input-output stock-flow consistent dynamic model

Topic: Energy policies
Author: José Bruno FEVEREIRO
Co-Authors: Oriol VALLES CODINA, Marco VERONESE PASSARELLA

We develop a 2 region Input-Output Stock-Flow Consistent model, where money is endogenously created, production is demand-driven, and the macro-economy is divided into industries that produce goods and services while generating waste and CO2 emissions and depleting natural resources. The model is empirically calibrated using EXIOBASE 3 input-output tables, aggregating the world into 2 regions (European Union and Rest of the World). The model is used to simulate the adoption of different Circular Economy practices, such as higher recycling rates, use of secondary materials and increased product lifetime extension. Preliminary results indicate that restructuring production and consumption patterns to adopt CE-driven practices within the EU provides positive impacts in terms of employment, GDP and in the trade balance, while leading to negative effects in the rest of the world trade balance. These results highlight the potential negative macroeconomics effects to global south countries, which specialize in the production and exports of raw materials, of a transition towards a more environmentally sustainable economy led by developed countries such as the EU.

Modelling of intermediate imports and external sector 'closure' in macrostructural models: A comparison between SFC-IO, Econometric-IO and CGE models

Topic: Special Session - Assessing Industrial, Trade and Green Transition Policies Through SFC-IO Models
Author: José Bruno FEVEREIRO
Co-Authors: Oriol VALLES CODINA, Marco VERONESE PASSARELLA

Traditional Stock Flow Consistent (SFC) models are typically aggregative/macroeconomic in nature presenting the economy as composed of only one aggregated productive sector. As such, there is no differentiation between the modelling of intermediate inputs and final goods. Consequently international trade is modelled as if consists only of final goods and following a post-Keynesian approach is modelled depending on disposable income (Godley and Lavoie, 2007), although some contributions have also included other determinants. As researchers seek to develop open economy multisectoral SFC models through the use of input-output tables, the question about how intermediate imports should be modelled emerges. This paper discusses different alternatives to modelling imports explored within the JUST2CE SFC-IO and its implications to the ‘closure’ of the external sector balance in line with the stock-flow norms. The paper closes with a comparison with the modelling of intermediate trade flows founds in Macroeconometric Input-Output and CGE models.

Macroeconomic implications for the global south of a green transition in the global north

Topic: Special session: Advances in Circular Economy Scenario Modelling
Author: José Bruno FEVEREIRO
Co-Authors: Benjamin H LOWE

Using environmentally extended (multi-regional) input-output analysis, this paper analyses the potential macroeconomic impacts on countries and regions in the global south of a reduction in the material footprint of countries in the global north. This reduction is achieved via two alternative scenarios, which are label ‘green growth’ and ‘degrowth’ the results of which are evaluated and contrasted. The paper uses data from EXIOBASE 3 for 49 countries and classify 'high-income' economies (as defined by the World Bank) as composing the Global North. Irrespective of the scenario, results indicate a fall in GDP and employment and a worsening of the trade balance (as % of GDP) in global south countries. These results highlight that, regardless of the strategy adopted, the green transition in the global north can lead to deteriorating living standards and trigger potential macroeconomic crises in global south countries under the current pattern of specialisation in production and trade. Therefore, a coherent and just green transition strategy requires that a reduction of material consumption in the global north be coupled with a necessary restructuring of the development strategy in the global south. This would involve moving away from neo-extractivism towards strategies more aligned with a post-growth notion, thereby reducing the reliance of global south economies on exports of raw materials and imports of manufactured goods.

A reformulation of the FLQ approach to computing regional input-output coefficients

Topic:
Author: Anthony T. FLEGG
Co-Authors: Fernando DE LA TORRE CUEVAS, Xesús PEREIRA, Napoleón Guillermo SáNCHEZ CHóEZ

In this paper, we examine alternative methods of computing regional input-output (IO) coefficients, with an emphasis on their relative accuracy and the complexity of the computations required. We propose a novel way of implementing the well-known FLQ (Flegg's location quotient) approach. Although the FLQ formula often yields very satisfactory results, the need to specify values of the unknown parameter δ in this formula presents an obstacle to its implementation. Here we develop a fresh approach to the use of the FLQ that substantially simplifies its application, while simultaneously enhancing its performance. We focus on how regional size, R, is incorporated in this formula and simplify the way in which R affects the allowance made for imports from other regions. We call this new formula the reformulated FLQ or RFLQ. We also show how the unknown parameter in the RFLQ can be computed. We test our proposal using the 2005 and 2015 Korean survey-based interregional IO datasets and contrast our estimates with both survey-based values and the results from several other techniques. We also examine two different information scenarios: with and without industry-specific information. The results suggest that the RFLQ can yield more accurate estimates of regional IO coefficients, and in a more straightforward way, than is possible with the traditional FLQ.
Keywords Regional input-output tables; non-survey methods; FLQ; RFLQ; 2D-LQ
Note: An earlier draft of this paper entitled "Curve shapes and parameters in FLQ regional modelling: some alternative approaches" was presented at the IIOA conference in Alghero. The present substantially revised version is currently under review by Computational Economics.

Where Did the Processing Export Relocate to? An Optimization-Method-based Identification

Topic: Trade and Global Value Chains Policies
Author: Xiang GAO

As the bellwether of global production relocation, capturing the international relocation of processing trade in the recent past would shed light on the current complicated production location reconfiguration. However, directly identifying the host economies of processing production is challenging because of the lack of data (countries across the world rarely distinguish the processing trade from ordinary trade). To overcome this challenge, the paper proves that the continuously decreasing DVASHGE is a sufficient condition for identifying whether a low-cost country is the host country of processing exports relocation, and put forward the idea of identifying the host economies according to their DVASHGE. On the other hand, measuring the DVASHGE based on the national or world input-output tables is not suitable for the paper due to the significant time lag of input-output data, the lack of data in low-income economies, and the lack of global processing trade statistics which will bias the results. Thus, the paper proposed a constrained weighted least squares optimization for unfolding the changes of DVASHGE in each specific economy.
In the empirical section, the paper selected 19 developing economies as the candidates for the host economy of processing production and conducted the empirical analysis of their DVASHGE. The empirical findings indicate that, since the global financial crisis in 2008, Vietnam's DVASHGE

has been continuously declining from about 0.60 during 2009-2012 to 0.50 during 2018-2020, confirming that Vietnam is the typical host economy of the processing production in recent years. Moreover, among the 19 candidates, Vietnam and the Philippines in Southeast Asia, Colombia in South America, and Tunisia in North Africa are the host economies of processing production; while Turkey in the Middle East also exhibits some numeric features for receiving such relocation, to some extent. Those economies also correspond to the extensions of three major regional production networks, i.e., the Asian production network centered on China, the American production network centered on the USA, and the European production network centered on Germany.
In the robustness check section, the paper has proved that the changes of the DVASHGE solutions remain robust and similar to that of the actual value, even if the macro-economic data is from different sources or the reference value is biased. However, it is important to note that the numerical results of the DVASHGE solutions presented in this paper are estimators and cannot replace the TiVA indicators measured based on input-output tables. In other words, the paper does not intend to substitute the input-output-based measurements with the proposed model. Instead, we believe that these two methods are essential complements since our DVASHGE solutions can provide an important reference for the GVC studies centered on input-output-based TiVA indicators.
In conclusion, this paper serves as an important starting point by introducing an approach to identify the host economies of processing production. Moreover, what characteristics makes them the host economies? What are the policy implications in the supply chain management and the GVC governance? These questions will be explored in our further researches.

Recent trends in international trade and their consequences on carbon footprints

Topic: Special session: Environmental impact of global value chains reconfiguration
Author: Ángela GARCíA-ALAMINOS
Co-Authors: Maria Angeles CADARSO, Luis A. LOPEZ, Maria A. TOBARRA-GOMEZ

By the end of 2019, international trade entered a phase of slowbalisation or deglobalisation after more than 30 years of continuous growth, with an increasing importance of reshoring trends. These trade-restructuring phenomena have been accelerated by geopolitical tensions and sudden shocks, which have highlighted the vulnerability of global value chains (GVC) and triggered significant economic, social, and environmental impacts related to their disruption. The response has led to prioritising the search for greater resilience in GVC, involving new reshoring, backshoring, nearshoring, and multisourcing schemes. All these strategies need to consider sustainability and carbon emissions to be effectively resilient, but also, at the same time, they are drivers of changes in global carbon emissions.

In this context, this paper aims to measure the magnitude of those relocation patterns in GVC and their impact on global, country, and sector carbon emissions, with a particular focus on the European Union (EU). For this purpose, we use an environmentally extended multiregional input-output model (MRIO) and the Intercountry Input-output Tables (ICIO) from 1995 to 2018 (OCDE, 2019) to calculate global emissions and carbon footprints under current trends of GVC and international trade. Additionally, we divide relocation trends into several components, isolating the effects of the geographical relocation of suppliers from 2008 onwards. Using the elements in the decomposition related to geographical shifts of suppliers, we can trace different trade-restructuration schemes such as backshoring, reoffshoring or offshoring.

Preliminary results indicate the relevance of the development degree of countries and the different patterns followed by domestic and imported emissions: domestic emissions slightly declined in the EU and USMCA, while increasing in China, BRIIAT, East Asian countries, and the rest of the world, with a more evident growth trend of imported emissions of these regions except for the EU. The reduction in the EU's carbon footprint in the period 200/-2018 is a result of changes in emission intensities, intermediate inputs, and the mix composing the final demand. Shifts in the geographical distribution of providers increased the EU's carbon footprint, but by a relatively small amount, particularly in 2008-2018. This indicates that relocation (reshoring, reoffshoring) is not decreasing emissions, at least up to 2018. Therefore, the environmental dimension is needed to achieve synergies between GVC reconfiguration, resilience and climate change goals.

An analysis of the Latin America Global Value Chain of Tourism

Topic: Trade and Global Value Chains Policies
Author: Nicolás GARRIDO

Integration in digital services around the world: a value-added approach

Topic: Trade and Global Value Chains Policies
Author: Enrique GILLES

This paper addresses the integration in digital services around the world, attempting to identify its main drivers and barriers. In the past decade, this sector production and exports have been growing at larger than average rates reflecting the increasing use of digital services in our everyday lives and production processes. In a world characterized by global value chains, the application of gravity models using gross trade has various shortcomings and does not reflect correctly the fact that several countries intervene in the production of other goods and services. Taking into account that issue, the research project considers value-added flows of digital services embedded in bilateral gross exports calculated from OECD's ICIO. It then proposes a gravity model that starts out from the standard formulation and considers other digital services related variables such as OECD's Digital Services Trade Restrictiveness Index (DSTRI). The equation is estimated using the Poisson Pseudo-Maximum Likelihood (PPML) method, to address missing bilateral trade data and heteroscedasticity issues. The paper can be understood as an updated version of other studies conducted at the global level. It also puts the focus on Latin American countries to assess on integration in digital services, for which no similar studies has been conducted so far.

Understanding the carbon footprint of electricity from wind and solar in European Union and their dependency on foreign supply chains: an input-output approach

Topic: Energy Policies
Author: Nicolò GOLINUCCI
Co-Authors: Lorenzo RINALDI, Matteo Vincenzo ROCCO, Emanuela COLOMBO

In the context of climate change concern and global economic instability, the European Union

(EU) aims to reduce the consumption of fossil fuels in favor of renewables in its power mix, increasing the penetration of photovoltaic (PV) and wind technologies in particular. However, similarly to fossil fuels, a significant share of the supply-chains of such technologies lies outside the European borders. To ensure a sustainable and secure transition, policymakers need to be aware of the environmental impacts of each technological alternative as well as their level of economic dependency on foreign supply-chains.

A first key question, therefore, is: (i) is it possible to determine the degree of dependency from foreign economies of new power generation technologies? Furthermore, how do they compare with fossil technologies?
Another crucial aspect, in line with the goals of the energy transition, is the ability of PV and wind power to generate electricity with significantly lower GHG emissions compared to fossil-fuelled alternatives. Nowadays, more and more emissions are being released to enable the production of transition energy technologies.
A second key question emerges: (ii) is what is produced today (i.e., photovoltaic panels and wind turbines) going to pay back the emissions required to produce it quickly enough?

Although many studies effectively address the second question raised, none attempts to answer the first, related to backward supply-chain dependency. Life Cycle Assessment (LCA) methodologies are largely based on physical information, which has only recently been integrated with economic information. Typically, such analyses are the domain of input-output-based LCA, where both economic and physical information are considered within the same analytical boundaries. The resulting methodology is usually referred to as Environmentally-Extended Input-Output (EEIO) analysis. However, when used for LCA analyses, these models usually exclude the impacts associated with capital expenditures. Nevertheless, it is possible to extend the matrix of intermediate transactions to explicitly include those supply-chains that produce capital goods for companies. Thus, a hybrid LCA analysis is used to get such results.

This paper contributes to quantitatively assess this information, adopting a multi-regional input-output model based on the Exiobase dataset, properly extended to explicitly model the manufacturing processes of PV and wind power plants in the EU. This is done by using a multi-regional input-output model that explicitly accounts for the capital expenditures of these technologies. The model is based on the Exiobase 3.8 database, which covers 200 commodities, 163 industries and 49 regions for the years 2011-2019. The paper also uses an open-source software (MARIO) to handle the model and ensure the replicability of the analysis. The paper provides indicators such as carbon and energy footprints, payback times, energy return on investment, and backward linkages. The model provides a set of insightful indicators such as environmental footprints, carbon and energy payback times and input-output backward linkages.

It is found that PV and wind technologies have relatively low carbon footprints (85.7 and 30.2 gCO2eq/kWh for PV and wind respectively) and exhibit comparable external dependency to fossil-fueled alternatives. Furthermore, they demonstrate a quick payback in terms of emissions and energy required for their production respect to their expected lifetime. Results are enriched with a sensitivity analysis considering different reference years of the Exiobase dataset and realistic ranges of technologies performances.

An Input-Output approach for the assessment of sustainability transitions

Topic: Energy policies
Author: Jorge Esteban GOMEZ-PAREDES

Achieving the urgently needed transition to sustainability is the biggest challenge of humanity today. Addressing such challenge calls for a profound understanding of the complex dynamics of social-ecological systems, where economic, social, and environmental dimensions interact with one another and impact each other. Recognizing the interconnectedness of these dimensions, it is clear that the assessment of how different economic activities contribute to or hinder such sustainability transitions demands a nuanced, multi-dimensional approach, commonly known as the nexus approach (Liu et al., 2018). This methodology involves the simultaneous consideration of economic, social, and environmental factors, unraveling both synergies and tradeoffs from different policies, activities, and strategies.
Building upon the established usefulness of Input-Output (IO) models in capturing economic influences across dense economic structures, and connecting production sectors and consumer products with several social and environmental indicators (extended models), including entire supply chains, this research picks up and expands the discussion on the applicability of IO for the assessment of sustainability transitions. To that end, the study addresses the following four research questions:
a) To what extent current IO models are suited for nexus analyses that can assess and monitor sustainability transitions; particularly in decisive and transversal economic systems such as the food and energy systems? This question is addressed through an updated literature review in view of the fast-expanding IO literature. The focus on food and energy systems responds to their pivotal role in the overall sustainability landscape, and their influence in many other sectors.
b) How can IO frameworks be adapted to better capture the complexities of social-ecological systems underpinning sustainability transitions through circular and bio-economy practices? Here, the study delves into the possible modification of IO frameworks based on the strengths and weaknesses of existing IO models that were identified when answering the previous question. This section of the article reflects the author’s commentary and perspective.
c) What are the some of weaknesses, strengths, limitations, data needs, and further research of using the proposed modified IO framework for sustainability assessments? This section, also based on the author’s perspective, discusses the strengths, weaknesses, limitations, data requirements, and further research needed, with respect to the adapted IO framework mentioned in the previous question.
d) How does the application of the proposed IO model compares with other common analytical approaches in terms of providing a more complete picture of sustainability? This last section, seeks to illustrate via a simple practical example the difference between the proposed model and current and traditional methods, thus showcasing how the former provides a more comprehensive understanding of sustainability. To the example uses data from statistical databases, such as the Eora Global Supply Chain Database (MRIO).
The novelty of this work lies in the exploration, discussion, and proposal of applying and adapting IO methodologies to assess important contemporary issues, such as the dynamics of social-ecological systems, nexus analyses, and sustainability transitions with a specific focus on food and energy systems, and circular- and bio-economy paradigms. In this way, the study aims to contribute to the ongoing discourse on tools to implement and monitor sustainability transitions, and to the development of robust analytical frameworks that can therefore guide decision making in our complex reality.

Liu, J., Hull, V., Godfray, H. C. J., Tilman, D., Gleick, P., Hoff, H., ... & Li, S. (2018). Nexus

approaches to global sustainable development. Nature Sustainability, 1(9), 466-476.

MEASURING PARTICIPATION AND IMPROVEMENTS IN THE BRAZILIAN PORT SECTOR

Topic: Industrial policies
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Transport is one of the pillars of a country's economy, being a key element for the development and expansion of productive capacity. Brazil occupies position 9 in the ranking of the largest economies in the world in terms of Gross Domestic Product (GDP), around US$ 3.21 trillion, representing a share of the world economy of 2.49%. In contrast, according to the 2017-2018 Global Competitiveness Index, developed by the World Economic Forum, the quality of Brazilian port infrastructure ranks 106th among a total of 137 countries. Therefore, the objective of this paper is to analyze the participation of the port sector and improvements in logistics infrastructure in Brazil, based on the disaggregation of port activities from the national Input-Output Matrix of 2015, using data from the National Input-Output Matrix and microdata from the Ministry of Labor and Employment for the year 2015. The methodology used to disaggregate the sector from the rest of the economy was the bi-proportional adjustment method (RAS). In turn, the impacts of investments were measured using Leontief's open and closed models. The contribution of the research is the development of a matrix estimation method that combines labor market microdata and complex networks. The results indicated that in Brazil the port economy represented 2.15% of the national GDP in 2015, equivalent to R$ 129 billion. Soon after, three investment scenarios in port infrastructure were constructed. In the most feasible scenario, investments of around R$ 195.9 billion generate an increase of R$ 320 billion in production, R$ 253.5 billion in Value Added, R$ 118.2 billion in exports and 3.7 million jobs direct and indirect effects on the national economy. The most impacted sectors in addition to the port subsectors themselves were: oil refining and coking plants, financial intermediation, insurance and supplementary pensions; oil and gas extraction, wholesale and retail trade and agriculture, support and post-harvest, which have higher levels of linkage with the port subsectors. In this way, improvements in the quality of port water transport; in land port transport; in port operations such as loading, unloading and agency; and in construction and infrastructure for the port sector, they provide competitiveness gains and positively affect sectors dependent on logistics.

Taking into account the interconnections (through complex networks) that the sector has in the production matrix, it was possible to verify that the segments in the service area were those that suffered the greatest impacts from investment shocks, a normal result as Leontief's production model is demand-driven. However, to a greater or lesser extent, all sectors of the economy end up being influenced by shocks, indirectly or induced.

In sectoral terms, oil refining and coke plants; financial intermediation, insurance and pensions; wholesale and retail trade, except vehicles; oil and gas extraction and support activities; ground transportation; legal activities; storage, transport and mail were the sectors most impacted in the three simulated scenarios, due to having a higher level of intersectoral relations with the port sector.

Considering the relevance of the national port sector for carrying out foreign trade, generating income and employment. The conclusions obtained are in accordance with the literature on Port Economics, which states that the sector is extremely important for the economic development of countries and that investments in this sector generate several economic benefits. It is expected that the methodology implemented in this study will contribute to the assessment of the main

economic impacts of improvements in the sector, and can serve as a support in making economic and political decisions that seek greater efficiency in port activities.

INTRASTATE AND INTERNATIONAL TRADE IN THE STATE OF PARANA: IMPLICATIONS FOR DOMESTIC VALUE ADDED

Topic:
Author: Carlos Alberto GONçALVES JUNIOR
Co-Authors: Raoni Felipe de Almeida ANDRé, Ricardo Luis LOPES, Umberto Antonio SESSO FILHO

INTRASTATE AND INTERNATIONAL TRADE IN THE STATE OF PARANÁ: IMPLICATIONS FOR DOMESTIC VALUE ADDED.
Brazil is a major global exporter of commodities, primarily in the agricultural sector. Paraná, situated in the southern region of Brazil, ranks fourth among Brazilian states in terms of GDP. Its economy is centered around agro-industrial products, excelling in supplying agricultural inputs to other Brazilian states and exporting products from the soybean and meat complex.
This study aims to scrutinize Paraná's integration into global value chains (GVCs) and the process of generating domestic value added (DVA) through its trade relations with other Brazilian states and key international partners, including China, the USA, Argentina, Germany, Netherlands, OECD countries, BRICS, other Latin American nations, and the Middle East.
To achieve this, an inter-regional input-output system was constructed for the 27 Brazilian states using the SUIT method, integrated into the Inter-country Input-Output System by the OECD. This study advances existing literature by examining DVA generated not only through international trade but also through trade between Brazilian states. This is crucial as intranational trade in Brazil is approximately 20 times greater than international trade.
Results reveal that the generation of DVA in Paraná is more pronounced through trade with other Brazilian states than through international trade. São Paulo, in particular, emerges as a significant contributor, responsible for generating US$15,550 million of DVA in the Paraná economy. This influence stems from São Paulo's economic size, boasting the largest GDP in Brazil and being Paraná's primary commercial partner, as well as geographical proximity with well-established transport infrastructure linking the two states' productive structures.
In terms of international trade, China holds the position of Paraná's principal trading partner, contributing the most to DVA in Paraná's economy, approximately US$3,047 million. Key exports to China include agricultural products, with a focus on soybean complex and chicken meat. OECD countries also maintain a robust trade relationship with Paraná, generating around US$3,853 million of value-added demand in Paraná's economy.
The agricultural sector prominently figures in Paraná's industries, with the highest DVA generated in exports to China and São Paulo, accounting for approximately US$3,596 and US$2,406 million of DVA, respectively. São Paulo's close ties with Paraná's agricultural industry are highlighted, as it houses a sizable portion of Brazil's food industry, relying on inputs from Paraná.
In conclusion, beyond international trade, intranational trade plays a pivotal role in DVA generation in Paraná's economy, especially in collaboration with São Paulo. Concerning international trade, the agricultural and food industry stands out, particularly in trade with China and OECD countries. Future studies can enhance this analysis by incorporating environmental variables such as CO2 emissions and Virtual Water.
Keywords: international trade, intranational trade, Domestic Value Added
JEL CODE: C-67, D-57, Q-56

Addressing technical issues in the compilation of the AfCIOT and TiVA indicators in Africa

Topic: Global Input-Output Accounts (GIANT): a collective initiative to harmonise input data entering ICIO tables published by international organisations (II)
Author: Xiaoning GONG
Co-Authors: Ana DEVEZA, Eleanor Carys Jerram KEEBLE

Dealing with negatives in commodity base technology: An optimal solution

Topic: Input-Output Theory and Methodology
Author: Andres GONZALEZ
Co-Authors: Xesús PEREIRA, Fernando DE LA TORRE CUEVAS

The compilation of national accounts heavily relies on meticulous data collection and organization, particularly through the creation of use and supply tables. These tables mirror national production from both demand and supply perspectives. However, integrating these tables necessitates making assumptions, especially regarding technology and other pertinent factors. It's crucial to note that these assumptions significantly impact the resultant figures. Among various assumptions proposed in the literature, commodity-based technology stands out for its favorable properties, despite posing certain challenges in its application. This paper introduces a novel methodology tailored to address a specific issue encountered in the construction process: the presence of negative values in the requirement matrices.
Our approach involves employing an optimization algorithm to mitigate negative values. This research aims to advance the field, offering a valuable tool for policymakers and statistical institutes in building and interpreting national economic data.

Interregional Input-Output Linkages and Relatedness as Drivers of Regional Diversification: Evidence from United States Counties

Topic: Special Session: IDE-JETRO & Statistics Netherlands Joint Special Session
Author: Simone Maria GRABNER

This paper examines the role of interregional input-output linkages and relatedness on industrial diversification of U.S. counties between 1998 and 2017. The hypothesis is that flows of intermediate goods and services among regions are a vehicle for the diffusion of external capabilities, upon which regional economies can thrive and diversify. Interregional linkages may also relax the role of relatedness, as external knowledge is likely to be unfamiliar, which provides opportunities for new and unrelated recombinations. To proxy interregional input-output linkages of counties we use a county centrality measure derived from the national input-output network. We find a positive relationship between county centrality and industrial diversification, where the latter is measured by the entry of new industry specializations. The results also show, that the impact of relatedness is weakened, if local industries are strategically interconnected within the whole input-output network. Interregional linkages via local industries that are prominently positioned within the national production system appear to stimulate regional diversification in general and unrelated diversification in particular.

A novel combined energy-material flow hybrid model under the Multifactor EEIOA Framework to study circularity and decarbonizing challenges of UK passenger transport

Topic: Special session: Advances in Circular Economy Scenario Modelling
Author: Zeus GUEVARA
Co-Authors: Luis Gabriel CARMONA

The transport sector plays a vital role in socioeconomic development, enabling the vast movement of people and goods. For example, energy flows, material flows, and material stock in the form of fuels, vehicles, and infrastructure, are required for motorized mobility. In addition, 28% of the UK energy-related CO2 emissions are caused by transport, which makes this sector the more significant emitter in the country; in comparison, the industry, which is responsible for material production, accounts for 19% of all UK territorial emissions. To achieve the national targets set out by the Paris Agreement, knowledge about the generation mechanisms of CO2 emissions within the value chain of transport services is needed. However, there is still a gap in understanding the complex interplay between factors of transport-related CO2 emissions as fuel combustion during the vehicle's operations is not only responsible for them; instead, other factors such as energy conversion, material stock turnover, and service delivery also contribute.

The present study aims to identify circularity and decarbonizing challenges for passenger transport services in the UK from the understanding of the trends in resource consumption of energy and materials in 1960-2015. To do so, we develop a novel exergy input-output model of energy and materials of the value chain of transportation services, which is constructed under the Multifactor Environmentally-Extended Input-Output Framework by Guevara and Domingos (2017).In addition, we apply a Structural Decomposition Analysis approach to this model to identify the driving factors of life-cycle CO2, energy and material trends across the value chain of transport services.

This model represents better the energy and material flows and the physical transformation processes that these experience across the value chain of transport services than any other available models. Moreover, it provides a comprehensive and detailed analysis of factor decomposition effects as it characterizes the energy and material exergy trends by an integrated model of 40 factors. For comparison, other conventional input-output models have less than five factors representing the whole value chain of goods and services. In most cases, two independent models are needed to account for energy and material flows. Another innovation of the model is that it includes the useful stage of energy conversion in the economy, while conventional analysis only considers the primary and final conversion stages. The latter allows a high level of detail in structural decomposition analysis, which is highly desirable for policy design, evaluation, and improvement. The model is built with energy use data from the Energy Balances and Statistics of the International Energy Agency and material balances data from Carmona et al. (2021) and Rodrigues et al. (2022).

The results reveal that the rapid increase in carbon emissions since 1960 is primarily attributable to the increasing prevalence of automobile use and the rising demand for services (measured in passenger-kilometer). However, energy efficiency (primary-to-final and final-to-useful) for both the energy conversion chain and the material transformation chain had somewhat attenuated the relative increase in CO2 emissions related to car ownership and transport demand. Moreover, the reduction of the embodied carbon intensity of materials is also an inhibiting factor that limited CO2 emissions. In addition, the energy and material conversion processes within the Iron & Steel industry had the most significant influence on the overall CO2 emission trends of transport

services compared to other industries involved. Finally, this study provides information on country-specific energy policy guidelines toward UK energy and emissions targets.

IMF Carbon Price Tool

Topic: Input-Output Analysis
Author: Joaquim J.M. GUILHOTO
Co-Authors: Gregory Max LEGOFF, Yamil VARGAS, Alberto SANCHEZ RODELGO

An effective way to reduce greenhouse gas emissions is to put a price on carbon. This approach, often referred to as carbon pricing, serves as a powerful incentive for economic agents to adopt more sustainable practices, leading to a more efficient use of energy and a subsequent reduction in emissions. This economic policy can take various forms, such as carbon taxes, cap-and-trade systems, or other market-based mechanisms. Understanding the impact of these policies on the economy is paramount for policy makers.
The Carbon Price Tool (CPT) developed by the International Monetary Fund (IMF) allows users to simulate the detailed impact of imposing a carbon price (measured in USD per ton of CO2 emitted) at the industry level within an economy including the propagation of price changes through the global supply chain. The CPT enables users to explore diverse scenarios, such as applying different carbon prices to 45 industries and 67 economies or country groups (e.g., EU or G7), facilitating a comprehensive analysis of carbon pricing effects across trading partners. Additionally, it opens the door to a broader discussion on Carbon Border Adjustment mechanisms, exploring how carbon pricing might influence international trade dynamics and competitiveness.
The underlying data driving these simulations comprises global input-output tables and emissions estimates for countries by industry. The modeling strategy employed is grounded in the Leontief Price model, allowing for a robust analysis of intricate economic interactions.
The CPT not only provides a user-friendly interface but also offers several functionalities. Users can assign different carbon taxes to industries and countries, compare scenarios simultaneously, visualize price changes by industry and by final demand components of GDP, explore the most impacted economies globally, and download results for further analysis.
Work is underway on the CPT to provide results that will break down household expenditure by income groups for a selection of countries and quantify revenues generated through carbon pricing in exports, imports, and final demand. The CPT will also include more countries in the analysis and provide a more detailed industry breakdown. Finally, in the long term, the CPT could incorporate price elasticities of supply, demand, exports, and imports, enabling simulations to estimate broader impacts on GDP, emissions, revenue generated and on competitiveness of countries.

Visualizing Global Value Chains: New Indicators for Assessing Domestic and Multinational Enterprise Dynamics

Topic: Input-Output Analysis
Author: Jiemin GUO
Co-Authors: Bo MENG, Jiemin GUO, Ming YE, Jiabai YE, Wenyin CHENG, Gabriele SUDER, Sebastien MIROUDOT

This paper utilizes the OECD inter-country input-output models and databases to develop novel indicators for visualizing global value chains (GVCs), explicitly considering the differences in production functions between domestic-controlled enterprises and foreign-controlled

multinational enterprises. The primary objectives are to create tools that enhance the understanding of GVC dynamics and provide actionable insights for stakeholders. We introduce three GVC visualization tools: smile curves, network diagrams, and value-chain based revealed comparative advantage (RCA) measures. These tools leverage the concepts of trade in value-added (TiVA), value-chain position, and value-chain length. The smile curve tools illustrate the value-added contributions, positions, and productivity of various countries, sectors, and firm ownerships within a specific value chain. Network diagrams uncover the controlling influence of different types of firms in terms of TiVA across countries and their evolution over time within GVCs. The value-chain based RCA tools assess the relative strengths or weaknesses of countries and firm ownerships in specific goods and services, based on TiVA flows. Our findings reveal significant variations in value-added contributions and control across different firm types and countries, underscoring the importance of nuanced GVC analysis. These insights provide valuable guidance for policymakers in crafting informed trade and industrial policies, for researchers in advancing GVC studies, and for business strategists in optimizing their value chain positions. Future research could explore the application of these tools in different regional contexts and industries, further enhancing their utility and robustness.

Decarbonization in Europe: a long-term view on the role of electrification

Topic:
Author: Sofia Teives HENRIQUES
Co-Authors: Laura FELICIO, Zeus GUEVARA, Ricardo PINTO, Tânia SOUSA

Introduction
Electricity is considered key for decarbonization and meeting the European Green Deal goals for 2050. One strategy to achieve these goals is by assuring 100% (or close) renewables in the EU power sector. A second strategy is to promote the electrification of final end-uses still dominated by fossil fuels, such as transport or industrial heat. Finally, electricity-based digital technologies can aid decarbonization by promoting energy and material efficiency in all economic sectors.
Deep electrification is a common goal shared by many EU member states for the future. Still, the process of electrification in Europe is not new, having occurred for more than one century. However, the impacts of renewable electricity and direct electrification were different across countries due to different levels of economic development, natural resources, and energy policies.
While the long-run impact of electrification on economic development has been studied from various angles, the long-period historical impact of electricity on energy efficiency or emission intensity has been less studied. This is somewhat surprising given that many European countries have witnessed a long-run decoupling of energy and emissions with economic development from the Second Industrial Revolution and a decline/stabilization in emissions from the 1970s, which coincides with the uptake of the Third Industrial Revolution.
This paper analyzes the long-term contribution of electrification on the efficiency and decarbonization of European energy systems, by comparing the long-term electrification path of four countries, Portugal, the UK, Denmark and Sweden with distinct resource endowments and climate, degrees of electrification and patterns of development.
To investigate the role of electricity in each country's energy efficiency and decarbonization, we use a combined EEIOA modeling and decomposition approach.
First, we build multi-factor physical input-output models of two indicators for each country: economy-wide energy efficiency (considering primary energy resources to useful energy services conversion) and total energy-related CO2 emission. Following Guevara and Domingos (2017),

these models disaggregate these indicators into structural factors that describe in detail the conversion processes and value chain of the energy flows production and consumption within these economies. Second, we evaluate the structural changes that the energy systems of these economies have experienced. Third, by applying a temporal structural decomposition analysis, we seek to understand how electricity contributed in each country to the energy efficiency and decarbonization of the overall energy system and what is the relative role of electricity services supply with respect to the supply of services by other energy carrier. Fourth, by applying a spatial structural decomposition analysis, we attempt to assess the reasons for differences in electricity efficiency and emission intensity trends across the four countries, as well as discuss different historical electrification rates across end uses. Finally, we perform an integrated analysis of results.
To do so, we use a newly constructed long-term primary to useful exergy flow database, developed by Felício et al (2019, 2023) for Portugal and extended by the authors to other European countries. This database details for each final energy carrier, their primary energy flows and associated carbon emissions, the mix of end-uses and the efficiency of conversion from final to useful exergy.
Our work identifies the main processes along the value chain of these countries' energy systems that influenced their trend of electrification and the trend of economy-wide energy efficiency. Also, we unveiled the structural factors behind differences in energy and electrification performance between these countries. The results contribute to the decoupling-degrowth debate and help develop systemic understanding of potential decarbonization paths of European energy systems.

No More Gambling: Estimating Non-Survey Regional Input-Output Tables by Averaging Location Quotients

Topic: Regional analysis
Author: Geoffrey J.D. HEWINGS
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Datasets containing regional input–output (IO) tables are not frequently produced by surveys but estimated using regionalization techniques. When the required information is available, an adjusting procedure of national IO tables based on RAS algorithms and its variants is widely applied. But if the required information is not at hand, a regionalization procedure based on Location Quotients (LQ) is the most popular technique. Broadly speaking, this class of methods consists of multiplying the national matrix of IO coefficients by a regional LQ, with the solutions suggested by Flegg et al. (1995) and Flegg and Webber (1997, 2000) extensively adopted and applied. However, some authors (Lehtonen and Tykkyläinen, 2012; Kowaleski, 2015) have criticized these solutions, arguing that they critically depend on the specification of an unknown parameter value: there is a multiplicity of estimated regional IO tables depending on this particular choice. In order to respond to these critiques, regression-based techniques have been proposed (see Buendía et al. 2022, for a recent example) to find "optimal" values for the parameter of interest.

A similar problem arises in a completely different field within economic modeling: in time-series analysis and particularly in the field of forecasting. In this branch of the literature, the use of forecast combinations has been extensively studied, and it has been empirically tested that forecast combinations produce a superior performance when compared with individual predictions. The initial work by Newbold and Granger (1974), Makridakis et al. (1982), Makridakis and Winkler (1983), have been continued by more recent studies, such as in Stock and Watson

(2004), Smith and Wallis (2009) or Genre et al. (2013). All provide examples of the empirical success of forecasting strategies consisting of computing a simple mean of individual forecasts. Through this averaging, the variance of the resulting predictions is significantly reduced and there are remarkable gains in terms of accuracy.

Based on this same idea, this paper proposes an easy-to-apply way of producing non-survey regional and interregional IO tables from national information and data in the form of LQs. Instead of relying on a specific parameter value that sets the values of the LQ applied, the resulting regional IO table is calculated as the simple average of several solutions produced by setting a range of plausible values for our LQs. The technique is illustrated and evaluated by conducting a numerical simulation similar to the exercise presented in Bonfiglio and Chelli (2009). Our results show how this simple approach alleviates largely the arbitrariness present in the choice of the parameter values for specifying the LQs, while reducing remarkably the risk of producing regional IO tables that deviate from the true ones.

A Shared Responsibility Analysis of CO2 Emissions from the Iron and Steel Sector in Japan

Topic: Industrial policies
Author: Seiya IMADA
Co-Authors: Shigemi KAGAWA

Japan’s iron and steel sector accounts for approximately 12.4% of Japan’s CO2 emissions in 2020. This sector has set a goal to reduce CO2 emissions by 30% by 2030 compared to 2013 levels. Introducing hydrogen technology and CO2 capture and storage technology is essential to mitigate CO2 emissions from the iron and steel sector. However, there is a cost associated with researching and developing (R&D) these technologies. In determining which sectors should bear these costs, the proportion of responsibility for CO2 emissions in each sector is crucial.

There are two main approaches to responsibility for CO2 emissions: the producer responsibility principle and the consumer responsibility principle. However, these principles assign all responsibility to either the producer or the consumer. Hence, cost allocation based on each principle may be unfair. This study addresses the following important research questions□some previous studies focused on the supply chain structure of the iron and steel sector, but they did not address the allocation of R&D costs. Additionally, since it focuses on a single aggregated ‘steel sector,’ it failed to elucidate the variations in the supply chain structure inherent to different steel products, depending on the manufacturing method (such as blast furnace and electric furnace methods).

The purpose of this study is to appropriately allocate the costs required for decarbonizing the steel sector among sectors directly or indirectly connected to it. This study employed the shared responsibility approach proposed by Gallego and Lenzen (2005) and clarified the allocation of responsibility for CO2 emissions between producers and consumers. The novelties of this study are twofold. First, empirically investigated how industrial sectors contributed to CO2 emissions from the iron and steel sector by steel manufacturing method in Japan (blast furnace method, electric furnace method). Second, this study further proposed a ‘practical’ cost allocation strategy for decarbonization in the iron and steel sector.

This study used the 2015 Japanese input-output table, which has high sectoral resolution and is subdivided at the steelmaking method level (blast furnace/electric furnace).

This study revealed that CO2 emissions from the passenger car sector and the non-residential construction (non-wooden) sector, based on the shared responsibility approach, decreased by approximately 70% compared to the consumer responsibility principle. On the other hand, CO2 emissions from the pig iron sector, based on the shared responsibility approach, increased by approximately 36,000 kt-CO2 compared to the consumer responsibility principle. Similar trends were obtained for CO2 emissions from the electric furnace sector. These results show that part of the responsibility for CO2 emissions, which was concentrated in downstream sectors under consumer responsibility, is dispersed to upstream sectors that produce intermediate goods and services under shared responsibility.

This study allocated the costs needed for decarbonizing the iron and steel sector based on the contribution of CO2 emissions from each sector under both the shared responsibility approach and the consumer responsibility principle. In the case of the shared responsibility approach, the passenger car sector would have to bear approximately 500 million JPY, whereas under the consumer responsibility principle, it would need to bear 8 billion JPY. Due to the disparities in CO2 emissions and burden amounts, estimating CO2 emissions and allocating costs based on the consumer responsibility principle were unfair and resulted in overestimation.

Finally, this study employed the shared responsibility approach to clarify the allocation of responsibility for CO2 emissions between producers and consumers. It suggested a practical cost allocation for green technology in the iron and steel sector based on estimated responsibility allocation.

The Carbon Footprint of Consuming Fish Species in Japan

Topic: Input Output Analysis and policies
Author: Hisashi ITO
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Global demand for fishery products is expanding due to population growth, the development of transportation system, and increasing health consciousness. Compared to agricultural and livestock products, fishery products have a smaller carbon footprint. Thus, in the context of a carbon neutrality, fisheries production is projected to expand. According to Robert et al. (2018), despite a minimal increase in global fisheries production from 1990 to 2011, greenhouse gas (GHG) emissions from fisheries have risen by 28%. Therefore, there is an urgent need to reduce GHG emissions from fisheries. However, GHG emissions from fisheries are still not clearly quantified, except for generalizations based on a limited number of case studies. To the best of our knowledge, this study is the first attempt to evaluate the embodied CO2 emissions induced by fisheries production in Japan, considering fishery types, fish species, and to suggest possible CO2 mitigation policies from the perspective of fishery types.

In this study, we quantify direct and indirect CO2 emissions from fisheries in Japan based on Embodied Energy and Emission Intensity Data for Japan Using Input-Output Table (3EID) using Environmental-extended Input-Output (EEIO) Analysis (Nansai, 2019). Fisheries production data published by the Ministry of Agriculture, Forestry, and Fisheries of Japan are utilized as final demand. We estimated direct and indirect CO2 emissions from fisheries production in Japan from 2011 to 2021 by fishery types, fish types, and fish species based on the data.

The empirical results show that annual CO2 emissions from fisheries production in Japan were

approximately 6 Mt-CO2, accounting for about 0.5% of the total annual CO2 emissions in Japan. The annual CO2 emissions from fisheries production increased from 2011 to 2015 due to the rise in the value of fisheries production caused by an increase in export value. In contrast, there was a downward trend from 2016 to 2020, with a 10.5% decrease. The main reason for this decline is the reduced production value caused by a decrease in the return and migration rates of various fish species, driven by changes in the marine environment.

In terms of fishery type, marine fisheries, representing approximately 70% of the total CO2 emissions from the fisheries, contributed to the decrease in annual CO2 emissions from fisheries from 2016 to 2020. It should be noted that the carbon intensity of marine fisheries is higher than that of other fishery types. Therefore, reducing the proportion of marine fisheries and increasing the share of other fishery types has significant potentials to decrease total CO2 emissions from fisheries.

In terms of fish type, we found that fish was the largest contributor to CO2 emissions from marine fisheries, accounting for 67% of annual CO2 emissions from this sector. Additionally, shellfish, which represents the second-largest share after fish, can also be produced through marine aquaculture. In other words, a shift from marine fisheries to marine aquaculture, especially for fish and shellfish, has significant potential for reducing CO2 emissions.

In terms of fish species, we identified the top 10 species that contributed the most to the total annual CO2 emissions from production of fish, accounting for 79% of the total annual CO2 emissions from this sector. Based on the Family Income and Expenditure Survey, the consumption of tuna, salmon, trout, and yellowtail is especially high in Japan, contributing significantly to CO2 emissions due to their large production value (Statistics Bureau of Japan, 2020). Shifting from marine fisheries to marine aquaculture for species in high demand, such as yellowtail, salmon, and horse mackerel can significantly reduce CO2 emissions. However, the number of fish species that can be produced by marine aquaculture is limited. In other words, the CO2 mitigation effect of shifting from marine fisheries to marine aquaculture is relatively small.

In conclusion, in a context where the production of fishery products in Japan will continue to heavily rely on marine fisheries, additional mitigation approaches, such as improving environmental efficiencies in the operation of fishing vessels, are needed.

Macro-Sectoral-Financial dynamics in Energy Technology Transitions

Topic:
Author: Andrew JACKSON
Co-Authors: Tim JACKSON

Limiting global temperature increases to 1.5°C will necessitate a transition away from fossil fuels and towards a net zero carbon energy system. While such a transition is necessary to avoid the catastrophic effects of climate change, it might also lead to a number of transition risks and transition opportunities. For example, a reduction in the demand for fossil fuels could lead to the stranding of fossil fuel related assets, reductions in the market value of fossil fuel firms, and defaults on fossil fuel firm debts. If large enough, these negative impacts could have (via their impacts on banks and financial markets) serious negative repercussions for the rest of the economy. In addition, a transition to net zero carbon energy system may lead to a decline in the energy return on energy invested (EROI) of the energy sector. Declines in EROI are likely to lead

to increases in energy prices and so the general price level, which are in turn likely to negatively affect economic activity. On the other hand, the large levels of investment required for the transition are likely to lead to significant increases in demand and so employment and output. Crucially, each of these risks and opportunities are likely to affect the different sectors and industries that make up the economy in different ways.

Despite the fact the macroeconomic, sectoral and financial implications of a transition to net zero are not well understood, to date only a small number of models exist that attempt to simulate the potential economic effects of different types of energy transitions. The majority of these models, however, do not include a financial sector or financial assets, and instead focus purely on the 'real' side of the economy. In addition, to our knowledge none of these models are able to simulate how the potential benefits of an energy transition (increases in employment and output due to an increase in green investment) are likely to interact with all the different potential risks (asset stranding, loan defaults, changes in equity market values, and reductions in EROI) along different transition pathways, or how sectoral specific impacts might feedback and affect other sectors and the broader economy. As such, the modelling of how asset stranding, changes in EROI, increases in green investment (and how that investment is financed) might affect the financial and real sides of the economy (and how these impacts might feedback and interact with each other) remains something of a gap in the literature.

In order to address this gap, this paper presents a stock-flow consistent (SFC) model with an integrated input-output (IO) model for the study of the economic and financial impacts of energy transitions, with a particular focus on energy investment, investment financing, capital asset stranding, changes in EROI, and sectoral impacts. The model consists of a household sector, a government sector, a banking sector, an external sector 15 non-energy firm sectors and 10 electricity sectors. Novel or semi-novel aspects of the model include multiple firm sectors and goods types, the integration of an input-output model and an almost ideal demand system into the larger SFC model, the endogenisation of firms' markups based on target profit rates and loan defaults that affect the bank's capital position and so its lending rates.

We use this model to investigate the economic impacts of different types of transitions to a low carbon economy. Particular focus is placed on the interactions between changes in EROI, fossil fuel firm asset stranding and financial transition risks (i.e. loans defaults and asset prices changes on financial markets), changes in investment and investment financing, and interactions between these factors and the different sectors that make up the economy.

Price dynamics in the global Input-Output economy: The case of the global car industry and climate policy.

Topic:
Author: Carlo JAEGER

(1) The research question pursued in the paper is:
When and why are many prices stable in the long run despite innovations in technologies and cultural values - and the reverse, i.e. when and why are breakthrough innovations in technologies and cultural values triggered by price changes?
(2) The method used is:
a case study over a century of price fluctuations, technological and cultural innovations (for good or for bad), with a focus on the car industry and related sectors like the oil industry.
(3) The data used are:

published input-output data that allow to construct a coarse input-output model of the world economy, published time series of the prices of selected goods, well documented analyses of technological and cultural innovations, and widely available data about global climate policy, including policy measures to increase carbon prices and reduce carbon emissions.
(4) There is a rich literature about price dynamics in Input-Output economies (e.g. Przybyliński and Gorzałczyński, 2022; Weber, Jauregui, Nassif Pirez, 2022; Aiwen Zhao, Ruilin Li, 2019) that clarifies the relations between critical prices and inflation indices as well as causal chains from a price exposed to an exogenous shock to other prices. The present paper investigates in new ways important interactions between price dynamics and technological as well as cultural innovations, interactions that so far have not been studied in-depth by Input-Output scholars. Building on marketing research that shows how prices often work as social norms (e.g. the seminal "Asking about Prices" by Blinder et al. and Thaler's emphasis on reference prices in mental accounting), the long-term stability of US car prices despite massive technological and cultural innovation can be understood.
While oil prices have experienced massive changes over their history, this has not led to a breakthrough of electric vehicles. Tesla's breakthrough, in contrast, was not due to a price advantage - quite the opposite - nor to climate policy. Remarkably, China triggered the impressive development of BYD and others to become highly successful producers of electric vehicles by inviting and fostering Tesla to establish its Shanghai gigafactory. With regard to the car industry, the European Union now finds itself in a dilemma: threatened by falling car prices from China it may implement protectonist measures in parallel with increasing gasoline prices; by opening the doors to Chinese cars the EU may reduce carbon emissions by accelerating its European Green Deal. The standard input-output price model will be essential to master the resulting challenge, but only if it is complemented by a new understanding of the interactions between price dynamics and different kinds of technical as well as cultural innovations.

DEPLOYERS: An agent-based modeling tool for multi-country real-world data

Topic: Trade and Global Value Chains Policies
Author: Martin JARAIZ
Co-Authors: Ruth PINACHO

We present recent progress in the design and development of DEPLOYERS, an agent-based macroeconomics modeling (ABM) framework, capable to deploy and simulate a full economic system (individual workers, goods and services firms, government, central and private banks, financial market, external sectors...) whose structure and activity analysis reproduce the desired calibration data, that can be, for example a SAM, or IOT or SUT.
Here we extend the previous work(*) to a multi-country version and show an example using data from a 36 countries, 64 sectors IOT. The simulation of each country runs on a separate thread (or CPU core) to simulate the activity of one step (month, week, or day) and then interacts (updates imports, exports, transfers...) with that country's foreign partners and proceeds to the next step. This interaction can be chosen to be aggregated (a single row and column) or disaggregated (64 rows and columns) for each partner. A typical run simulates thousands of individuals and firms engaged in their monthly activity and then records the results, very much like a survey of the country's economic system. This data can then be subjected to, for example, an Input-Output analysis to find out the sources of observed stylized effects as a function of time in the detailed and realistic modeling environment that can be easily implemented in an ABM framework.
As an example, a typical personal computer with 4 cores can run the simulation of Spain with France as disaggregated, and Germany, the US, and the Rest of World (RoW) as aggregated

external sectors. These three countries are simulated each on a core. The computation time is approximately 2 to 4 times a simulation of only Spain plus the RoW (minutes or hours), because of the 64 external sectors rows and columns from France. Memory requirements are not a limiting factor. Thus, hardware with 36 cores can run a World simulation with the 36 countries plus the RoW, each interacting in detail with a few of its most active partners.
This development enables the use of the ABM approach as a tool for IOT analysis and policy making, that was hindered by the difficulty to initialize an economic system that could mimic the real one to be simulated. It also paves the way for unleashing the expected high performance of ABM models to deal with the complexities of current global macroeconomics, including other layers of interest like ecology, epidemiology, or social networks, among others.

(*) “An agent-based modeling approach for real-world economic systems: calibration with a Social Accounting Matrix of Spain”, 29th IIOA Conference in ALGHERO, Sardinia, Italy. (Abstract + Paper)

Integration in the Global Value Chain and the Gender Employment Gap: Case of China

Topic:
Author: Xuemei JIANG
Co-Authors: Xinru LI

The gender gap is a phenomenon that transcends the majority of the world’s cultures, religions and income groups. Despite the great importance attached, the most recent “Global Gender Gap Report 2023” released by World Economic Forum (WEF, 2023) shows that at the current rate of progress, it will take 131 years to reach full parity, which represents a more than 30-year deterioration compared to the 2020 estimate (~100 years to parity). In this paper, we selected China as a case to explore the relationships among the integration in the global value chain and the gender employment gap, as China has witnessed a widening gender employment gap (GEG) by 9.64% in the past two decades 2000-2020, indicated by the labor force participation rate (LFP) of male minus LFP of female. More specifically, we distinguish domestic demand and different types of Global Value Chain (GVC) -- related demand under the inter-country input-output framework, and propose a new gender gap decomposition model to explore the evolution of GEG of China from demand-side perspective. Our empirical results suggest that GVC-related activities only contributed to the widening of GEG in China by less than 0.60% between 2000 and 2020. In contrast, increasing gender discrimination toward female and technological progress with a rapid decrease in employment when producing the same amount of output in most female-intensive sectors are the dominant reasons behind the widening GEG of China. Our case analysis of China suggests that the stimulations of the LFP of female both on the sides of employers and employees are eagerly required to reduce gender gap worldwide.

The Analysis of the Structure of China's Digital Industrial Base on the Complex Networks

Topic: Industrial Policies
Author: Zhijian JIANG
Co-Authors: Xu JIAN

The industrial structure directly reflects the level of regional economic development and overall quality, and the interdependence and mutual constraints of the correlation structure between

industries directly affects the current characteristics of the regional industrial structure and its evolution process, reproduces the correlation relationship between industries, and determines the role of each industry in the industrial linkage, which is conducive to regulating, optimizing and upgrading the regional industrial structure. Industrial linkage refers to the technical and economic links between industries with various inputs and outputs, including forward, backward and sideways linkage between industries. Input-output analysis is the most important analytical method, which is based on the general equilibrium theory and discusses the closeness of inter-industry linkage and the shape of linkage from the perspective of consumption and distribution among industrial sectors. At present, a large number of studies calculate the indicators characterizing the strength of industrial linkage according to the input-output table, and classify the industrial sectors according to the size of the indicators, among which the influence coefficient and induction coefficient are the most commonly used. These two indicators have two obvious problems, which are not conducive to the discussion of inter-industry relations. Firstly, they emphasize the backward and forward linkages between industries, but neglect the sideways linkages, and the linkage measurement is not comprehensive; secondly, these two indicators measure the global linkage effectiveness of a certain industry, but not the inter-relationships between specific industries. In order to more clearly show and analyze the network composed of forward, backward and lateral links between industries, with industries as nodes and links between industries as edges, the idea of complex network analysis can be introduced.

This paper tries to propose a metric method of industrial linkage on the basis of domestic and international research on complex industrial linkage networks, analyze the network structure characteristics of the effective linkage network of regional digital industries, and extract the key industries that play an important role in the network. It tries to answer the following two specific questions: (1) What is the location of linkage of related digital industry sectors in the network? In the industrial network, the degree of closeness of inter-industry links varies, and industries are either at the center or edge of the network links, or at the articulation position between associations, playing the efficacy of direct control, indirect control, etc., which is closely linked with the industrial development dynamics. The above network effectiveness of industries has the difference of network scale, and some industries play an effective role in the whole network, while some industries play an effective role within the associations. So, which industries have global effectiveness? Which industries have localized effectiveness? What kind of regularity exists in the connection between industries? (2) How is the network as a whole connected? Is there any industrial association? If so, what are the differences between them? How is the connection between industrial associations realized? Effective answers to these fundamental questions will facilitate the later research to re-examine the characteristics of digital industry structure from the perspective of inter-industry connections, add a new influence factor to explain the differences in the development of each digital industry through the analysis of the differences in the positions and roles of specific industries in the industrial network, and analyze the evolutionary process of the digital industry structure through the changes in the network roles and positions of specific digital industries and the perspective of inter-industry interactions, so as to provide a better understanding of the evolutionary process of digital industry structure. Through the changes of network roles and positions of specific digital industries, we analyze the evolution process of digital industry structure from the perspective of inter-industry interaction, so as to provide scientific basis for the formulation of industrial guiding policies, such as optimization and adjustment of digital industry structure.

Exploring the role of GVCs in economic diversity

Topic: Trade and Global Value Chains Policies
Author: Sofía JIMÉNEZ
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Since the beginning of the so-called third globalization wave in the las 90s and first 2000s, countries have been increasingly connected. In that way, economic growth and income generation has not been longer studied without considering the crucial role that the dynamics of international trade plays. The best representation of this globalization and international interdependence networks has been the concept of global values chains (GVCs). Indeed, the expansion of GVCs has changed the interpretation of the economic policies and allows to obtain better answers to questions such as the evolution of the specialization patterns, the analysis of trade policy, or the international transmission of shocks.

In relation to GVCs two concepts stands out, participation and position, as a way to approach the engagement of countries and regions in GVCs and to capture the benefits of this strategy. Different metrics have been proposed in the literature to approach this concept, most of them considering the market share or different types of competitiveness index. In the other hand, position has been conceived as an approximation to the distance of the countries or industries to the final demand. This position is key in explaining the uses of profits derived from trade, as suggested by the smile curve hypothesis.

Besides, economic literature has traditionally focused on the impact of exports variety on economic development. The most extended idea is that exports diversity is positively related with economic growth, although there are some studies that suggest the non-linearity of this relation. Exports diversity and GVCs are two elements derived from the same phenomenon, and, thus, they might be strongly correlated. In this context, the main aim of this work is to analyze the relationship between exports diversity and participation and position of GVCs. Besides, we will also explore the results in function of the level of relatedness of the exports basket of each country. Relatedness could be defined as the technological similarity between the products/sectors exported.

To carry on the analysis, we will work in a multiregional input-output framework, using as a main database the inter-country input-output database provided by OECD (it contains higher level of sectoral disaggregation than other datasets). We will calculate participation using the measure proposed by Bolea et al. (2022), which is a proxy of economics competitiveness. To calculate position, we follow the proposal of Antràs et al., (2012). Exports variety would be calculated using an entropy measure. Estimations will be done through a panel data model in which exports diversity would be the dependent variable and participation and position the independent. Besides, exports relatedness would be calculated following the methodology of Savioti and Frenken, (2008).

First results suggest a non-linear relation between both indicators, exports diversity and participation and position. In particular, those countries that are more upstream (focus on intermediate inputs) and participate more in the chains seem to be more diversify. We expect to get differences in function of the relatedness of exports.

Spatially explicit analysis of regional freshwater boundary exceedances embodied in international trade

Topic: Sustainable Production and Consumption Policies
Author: Huo JINGWEN
Co-Authors: Xu ZHAO

The regional freshwater boundary set restrictions on water use, and the regional freshwater boundary exceedances (RFB exceedances) not only poses a threat to national sustainable development but also has further global impacts through the transmission of global supply chains. Considering the regional heterogeneity in water resource endowments and water consumption, we analyzed the RFB exceedances embodied in global trade at grid scale.

We estimate the RFB exceedances embodied in trade by using the EMERGING MRIO tables (covering 245 economies and 135 sectors) in 2015 and the emissions embodied in mutual trade (EEBT) method, which analyzes mutual interconnection between industries in different regions due to trade-adjusted emission changes and assess attributions of environmental changes both from production and consumption. We also construct the inventory of water withdrawal and RFB exceedances based on global gridded water withdrawal across five sectors (Irrigation, Livestock, Manufacturing, Electricity, and Domestic), to link with the EMERGING. Here, we found that East Asia, North America, and West Asia are the main importers of RFB exceedances, while Central and South Asia are the main exporters, accounting for 46.4% of global total RFB exceedances embodied in imports and exports, respectively.

Due to the southward shift of industries, in addition to the traditional agricultural sector, the exports of machinery manufacturing and textile sectors are also the main contributors for RFB exceedances, especially in emerging economies. For example, in 2015, the net export volume of embodied RFB exceedances in India's petrochemical sector trade was 9.8 km3, accounting for 10.1% of the total net export volume of embodied RFB exceedances. China's Textile, Machinery, and Equipment sectors have the net export volume of 25.2 and 23.8 km3 of embodied RFB exceedances, accounting for 70.0% and 65.9% of the total net export volume of embodied RFB exceedances, respectively. This will lead to increased water pressure in major exporters such as China and India in their central urban cities and surrounding watersheds to meet the consumption from other economies.

Moreover, economies with a high RFB exceedance rate imply a high-risk level for water sustainability, although they currently do not possess the largest water withdrawal. For example, economies with the highest exceedance rates are concentrated in the Middle East and Central Asia, including Bahrain, Egypt, Kuwait, the United Arab Emirates, Saudi Arabia, Iraq, Uzbekistan, and Turkmenistan (Figure 3a). In these countries, over 90% of water withdrawal exceeds their RFBs. From the consumption perspective, their exceedance rates are generally lower than those on the territorial side. This is attributed to the significant water scarcity faced by the Middle East and Central Asia, posing a substantial risk to local water resources for production. The potential threat to global water resources diminishes when importing products to meet consumption demands. In contrast, the countries with the highest RFB exceedance volume do not necessarily have the highest exceedance rates. India, China, and the United States, for instance, exhibit exceedance rates of around 60% from both territorial and consumption perspectives.

Our results analyzed the trade flow patterns of embodied RFB exceedances at the regional grid scale and proposed targeted local water management strategies. For example, strengthening the development and transfer of Water-saving equipment and technology to promote the declining of the RFB exceedances in emerging economies and promoting comprehensive responsibility sharing and compensation schemes to alleviate the increasing REF exceedance pressure caused by international trade.

Analysing the Macroeconomic and Decarbonisation impacts of Green Hydrogen Mandates in key Asian economies: China, Japan, India and South Korea

Topic: Input-Output Analysis
Author: Surabhi JOSHI
Co-Authors: Kakali MUKHOPADHYAY

Green hydrogen is expected to play a key role in achieving the goals of the Paris Agreement by mid-century. Further, in the context of global net zero trajectory, strong growth in hydrogen market and green hydrogen deployment is envisaged to potentially offset over 60 gigatons of CO2 (~ 6.5% of total reduction) in accumulated emissions between 2021-2050 (IEA,2023).

Presently, hydrogen is mainly produced from natural gas, with modest trade volumes. However, trade in hydrogen-derived commodities, such as ammonia and methanol, is substantial, valued at $17.5 billion and $14.1 billion respectively in 2022(IRENA & WTO, 2023). In a net-zero scenario, trade dynamics for green hydrogen and its derivatives will differ markedly from today's fossil fuel markets due to widespread production potential linked to solar and wind power.

Under the pretext, four major Asian economies i.e. Japan, China, India and South Korea have proactively come up with ambitious targets to promote manufacturing, use and trade in green hydrogen supply chain. This research work initially evaluates the targets, policy incentives and existing ecosystem for green hydrogen manufacturing in the four economies. This is followed by quantitative analysis including constructing economy specific green hydrogen production block. The production block estimates required investment in specific electrolyser capacities, hydrogen pumping and storage infrastructure along with renewable energy capacity requirements for fulfilling the existing targets for green hydrogen manufacturing with the data corroborated from various technical sources and existing literature as appropriate. Further, using E3ME model (Cambridge Econometrics, 2022): a global integrated dynamic macro-econometric simulation model we evaluate and compare the following:
1. Macro-economic impacts of scaling up green hydrogen manufacturing aligned to the existing policy target in the four economies in terms of GDP, employment and sectoral outputs
2. Decarbonization potential of mandated green hydrogen manufacturing targets for the four economies with the manufactured green hydrogen replaces equivalent blue /grey hydrogen in the economy
3. Impacts on trade in terms of reduction in fossil fuel imports for the four economies and increase in exports for commodities, technologies and services
4. Impacts of import substitution in key hydrogen value chain sectors for the economies

As the technical and economic challenges of long-distance hydrogen transport remain significant, trade in green hydrogen is likely to manifest predominantly through commodities produced with hydrogen, like ammonia, methanol, synthetic fuels, or iron. The potential for cost-competitive green hydrogen production in regions abundant in high-quality renewable energy could lead to the relocation of energy-intensive industries and the emergence of new commodity trade routes. Additionally, as green hydrogen scales up for decarbonization, there will be a notable increase in trade flows for the technologies and services needed for its production, such as electrolyzers, compressors, pipes, and valves.

The ability to capitalize on the advantages of the emerging global green hydrogen value chain will vary among economies, contingent upon their respective technological, economic, and policy frameworks. This comprehensive analysis delves into the macroeconomic implications,

decarbonization potentials, trade dynamics, and import substitution effects of the green hydrogen scale up in four different Asian economies. This research works aims to contribute to new body of literature providing a quantitative evidence for the diverse opportunities associated with the transitioning to green hydrogen, not only limited to advancing the objectives of the Paris Agreement but also tending to sustainable economic growth opportunities across Asian economies.

Labour shortages, labour mobility and regional impact analysis

Topic: Regional analysis
Author: Eleanor Carys Jerram KEEBLE
Co-Authors: Kurt KRATENA, Matthew LYONS, Huanjia MA

Labour shortages, labour mobility and regional impact analysis
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Abstract
This abstract presents a multi-regional input-output (MRIO) model for the UK, integrating labour dynamics to analyse labour shortages, mobility and their regional impacts. By endogenizing labour and allowing for varied elasticities between labour and capital, the model captures the nuances of labour market tightness and its effects on wages. It incorporates a matching model to detail the mobility within and between occupations and regions, highlighting the interplay between labour supply constraints, wage-price feedbacks and demand-side adjustments.
Following the framework of Lankhuizen et al. (2022) and Diodato and Weterings (2015), our model introduces labour as a dynamic component. Labour is substituted against capital with a large heterogeneity of substitution elasticities, ranging from zero to values beyond unity. These factor demand functions are combined with Leontief technology for intermediate inputs and mark-up pricing.
Wages by occupation and region react to labour market tightness estimated using regional unemployment levels along with individual and regional fixed effects, similar to the classic Blanchflower and Oswald (1994) model. In turn, regional unemployment by industry is estimated in the model through a matching of the labour market with full mobility across industries within occupations, and limited mobility between occupations and regions. Lankhuizen et al (2022) have used this matching approach to show the discrepancy between employment effects from a type I (pure Leontief) model and employment effects with fully binding labour supply constraints. We extend this approach (i) by the income-consumption multiplier effects from employment generation and (ii) by feedbacks on wages and prices from matching between vacancies and unemployment (at the occupation-region level). Compared to an unconstrained macroeconomic IO model, the labour supply shortages reduce the employment/income effect, so that household demand also adjusts due to the constraints. Higher labour demand pressure also feeds back on wages and prices and therefore on consumption as well as on labour demand.
On the final demand side, aggregate private consumption depends on real disposable household income, which is also influenced by feedbacks from the price side as well as by fiscal policy (transfers and tax rates). The structure of household expenditure is specified in a simple household demand system. Gross fixed capital formation, public consumption and foreign exports are the exogenous parts of final demand.
This approach provides insights into the macroeconomic feedback mechanisms, particularly in regional impact analyses, underscoring the critical role of labour market dynamics in understanding economic resilience and policy implications. The macroeconomic feedback

mechanisms in our IO model (income/consumption and prices/demand) explicitly describe the adjustment of the demand side to supply constraints, which is especially relevant in the case of regional impact analysis.

Compilation and Use of International Financial Input-Output Table

Topic: Financial analysis
Author: Jiyoung KIM
Co-Authors: Satoru HAGINO

The development of global Flow of Funds Accounts (FFA hereafter) has been primarily driven by the International Monetary Fund (IMF, hereafter), which is responsible for monitoring global financial system functions. For example, in line with the global FFA scheme of Errico et al. (2013, 2014), the IMF has worked on improving relevant international statistics, such as those of the Coordinated Portfolio Investment Survey (CPIS) and the Coordinated Direct Investment Survey (CDIS). Global FFAs, however, have not yet been produced, in a complete form mainly due to the absence of national “from-whom-to-whom” FFAs to be combined as the integral segments of global FFAs.
Against this backdrop, this paper term global FFAs international financial input-output table (IFIOT hereafter) and produce trial estimates for the IFIOT covering multiple countries; it compiles and analyzes such accounts with a focus on the global financial crisis. we compile "from-whom-to-whom" financial tables for some countries, and combine these tables to generate a three-area international "from-whom-to-whom" financial table (in other words, IFIOT). Using input–output analysis method, the power-of dispersion indices in liability-oriented system and asset-oriented system are obtained.
Then, we discuss the potential use of an IFIOT. For example, At the 2023 International Input-Output Analysis Association Conference, we tried to analyze the monetary policies of the Federal Reserve Board (FRB hereafter) of the United States using three areas of IFIOT, induced net financial positions and net induced savings are calculated and decomposed by the FRB. At the conference, one participant cast a doubt about the treatment of excess assets and excess liabilities as exogenous sector, indicating that by expanding the country coverage, excess assets and excess liability become endogenous sector. Our reflection on above-mention problem is that the exaggeration is due to the treatment of treating the rest of the world as endogenous sector. As to the framework of IFIOT, we revisited the issue of how the rest of the world should be treated in the calculation of inverse matrices. Another participant suggested us to create the IFIOTs for long-term which covering more couintries (or areas). We revised our tables and analysis methods adopting helpful advices and suggestions. We would like to continue our reflection, referring to the framework of industrial input-output analysis.

Measures of upstreamness and downstreamness defined on exports

Topic: Trade and Global Value Chains Policies
Author: Alvaro LALANNE

In this article I discuss and develop measures of Upstreamness and Downstreamness to describe the position of countries and sectors in global value chains. Both measures are defined as distance from exports either to final demand (Upstreamness) or to primary factors (Downstreamness) and can be summed in a single measure of length and position of chains in

international trade. I show the usefulness of these measures to highlight some aspects of international participation in value chains that cannot be deduced from previous measures. In particular, the specialization of countries along value chains is better described with the measures proposed here.

Temporal Dynamics of Production Technology and Final Demand: Evaluating New York’s Forest Sector Output Contribution along its Supply Chain and Value Chain.

Topic:
Author: Basanta LAMSAL
Co-Authors: Mariela CAVO, John Wagner ERIC

This study examines the trend of economic contribution of the NYS Forest Sector over a 22-year period, focusing on how the sector has influenced the state's economy through its supply and value chains. Utilizing the Input-Output framework, the analysis looks into the sector's role in supporting local industries by providing inputs and purchasing outputs and how shifts in production technology and final demand have impacted its economic contributions over time. The total output change was decomposed over time to analyze the changes in the sector's economic contribution attributed to the changes in Production Technology and the changes in Final Demand. Further, the column space expansion of these changes was carried out by diagonalizing the final demand vector, allowing us to examine the detailed study of trend analysis along the supply and value chains of the sector. The developed model was used to study the dynamics of production technology and the final demand of New York State’s Forest Sector.
The study reveals a significant decline in the New York Forest Sector's output, attributable to reduced demand and external economic pressures, including the impacts of the 2008-2009 Great Recession and the COVID-19 pandemic. Despite an increase in local input usage, which contributed to a 4.2% rise in output due to technological advancements, the overwhelming decrease in final demand led to a substantial fall in overall sector output. In fact, over the 22 years, the sector experienced a notable downturn, with a 33.3% decrease in production along its supply chain. The study further identifies a declining demand for forest products within the sector's value chain. Over 22 years, the NY Forest Sector’s total gross output decreased by about 34%, of which 30% was attributed to the change in final demand and 4% was attributed to technological change. However, a modest recovery observed in 2022 indicates a potential shift towards more localized supply chains, suggesting a growing preference for intra-state trade, which could provide long-term benefits to the sector. Further, despite the reduction in total output contribution, the NY Forest Sector exhibited signs of resilience and potential for recovery, particularly in the years following the great recession and up until the onset of the pandemic. The findings highlight the importance of understanding sector-specific dynamics and the need for targeted policy interventions to support the forest sector's resilience and growth.

The IMF Multi-Analytical Regional Input-Output Model - MARIO

Topic: Global Input-Output Accounts (GIANT): a collective initiative to harmonise input data entering ICIO tables published by international organisations (II)
Author: Gregory Max LEGOFF
Co-Authors: Joaquim J.M. GUILHOTO

Input-output tables represent a unique source of information to understand the relationships between producers and consumers within an economy and their interconnection with: a) the environment through emissions of CO2, other pollutants, the use of land and natural resources, b) energy and physical accounts; c) employment; d) tax gaps as well as fiscal policies related to climate change adaptation and mitigation; e) income distribution; f) trade in value added, and so on. The IMF has started developing a Multi-Analytical Regional Input-Output model (MARIO) to provide a powerful analytical tool and a source of harmonized granular data to better understand the inter-relationships between economies, their impact on climate change, and their economic and social development. Linking domestic input-output tables together in a consistent multi-regional model will help improve data consistency within and across economies. MARIO's development will take advantage of already available data from different global input-output tables initiatives; statistical offices; and international organizations, including official source data collected by the IMF from its member countries. This will reduce the amount of missing data encountered in the estimation of multi-regional input-output models. The IMF is in a unique position to develop a model with global geographic coverage while also improving cross-country and global data consistency. Through cooperation with other international organizations, under the GIANT initiative, MARIO will cover the years from 1990 to 2022 and 212 economies, including all IMF members. The model will encompass 178 products and 144 industries, providing sufficient granularity to perform detailed analysis on themes related to climate change and the environment and will capture international spillovers providing the ability to analyze the energy transition, emissions, material flows, and other questions of strategic importance.

Comparative Analysis of S&T Service Industry and Related Policy Impact in Bejing and Shanghai

Topic:
Author: Shuxia LEI
Co-Authors: Zhang SHIYUN, Rui XUE

The role of science and technology (S&T) service industry has become more and more important for an economy. This paper comparatively analyzes the size, development environment, and influencing factors of S&T service industry in both Beijing and Shanghai. The key question is whether the development of S&T Service industry can effectively promote the upgrading of other industries? First of all, this paper will select data from 2012 to 2022 Chinese Provincial statistical Yearbooks, combine different related industries for a whole S&T service industry in both two cities. Then, it analyzes the basic situation of S&T service industry from the perspective of the whole and sub sectors by using PEST method. Moreover, it uses the measurement model to analyze the influence of factors for the development of S&T service industry from a static and dynamic perspective. The current results show that five factors, including S&T activities personnel, fixed asset investment in scientific and technological services, the number of employees in S&T services, the amount of patents, and the amount of foreign capital used, have a significant impact on the development of S&T services industry in Beijing. Third, in order to measure the impact of S&T Service Industry on other industries, and the structure change in the

whole regional economies, by using the data from Input-output Tables of China and two cities for the period 2002-2020, this paper will also do some input-output analysis and some policy simulation. Finally, based on these comparative analysis and policy simulation results, this paper will summarize the different influencing factors for the two cities, and give some recommendation for Beijing to promote the S&T Service Industry.
Key Words: S&T Service Industry, PEST method, Input-output Analysis

There is no Sraffianism in one country: exploring the interest-profit nexus

Topic: Input-Output Analysis
Author: Fabrício Pitombo LEITE

A well-known claim associated with some Sraffian economists, e.g. Pivetti (1985; 1991) and Panico (1988), follows the idea that the rate of profit is "susceptible of being determined from outside the system of production, in particular by the level of the money rates of interest" (Sraffa, 1960, p. 33). By exploring the World Input-Output Database (WIOD), for both the long-run version for the period 1965-2000 and 25 countries and the 2016 release for the period 2000-2014 covering 43 countries, this paper tries to make sense of Sraffa's suggestion. As the database contains an estimation for the rest of the world in both cases, world input-output tables can be computed for each year and, from the same dataset, also national input-output tables by country. For the long-run WIOD, it is possible to compute the maximum rate of profit considering only circulating capital and establish its relationship with an interest rate. Along this research, OECD (2024) long-term interest rates were the choice on empirical grounds, but the use of a long-term rate can also be justified by theoretical reasons. For the 2016 release, besides the maximum rate of profit for circulating capital, the Socio-Economic Accounts (SEA) allow the calculation of national maximum rates of profit considering both circulating and fixed capital, as estimates for the capital stock are available, and also of general uniform profit rates, as the wage-shares can be computed from the same dataset. One clear regularity emerges from the data: in spite of the relationship between the interest rate and the profit rate is found to be null or negative for most national data, and also negative for pooled data for the period 1965-2000, the relationship between virtually any national interest rate and the rate of profit taking the world as a whole is definitely positive. Naturally, this finding also relies on the fact that most long-term interest rates in the world are highly correlated. For the period 1965-2000, major countries like France, Great Britain and the United States presented interest rates negatively correlated with their national maximum rate of profit, but positively correlated with the world maximum rate of profit. It has been shown that a panel would find a positive relationship for the period 2000-2014, but one that is contingent to few extremely influential observations for a couple of countries - besides visual inspection, statistics for influential observations have shown the Greek and Lithuanian cases as the most conspicuous. National evidence of this correlation is much more mixed for the period 2000-2014, but, with the exceptions of Portugal and Greece, which was struggling with its worst economic crisis in history at that time, it is very indicative that none of the other countries with complete long-term interest rate series experienced negative correlations between national interest rates and world maximum profit rates. Even the case of Greece is very peculiar: the skyrocketing interest rates by the crisis period occurred with concomitantly large profit rates inside the country, not matched by similarly high world profit rates. It is also interesting that flat relationships with national profit rates as in Norway, Sweden or the United States have been turned out to be very strong and positive in the world profit rates case. The data deducting countries' wage-shares show the inversion of the relationship interest-profit in the United States and in Canada. In the opposite trend, from a negative relationship between interest rates and

maximum rates of profit to a positive one with general rates of profit, Brazil has experienced a significant change in its wage-share in the period. The explanatory power for pooled data is superior when general rates of profit are taken instead of maximum rates. As long as wage-shares are not available for the proxy for the rest of the world, a 43-country general rate of profit was calculated and most of the results did not indicate a better adjustment than the obtained for the world maximum rate of profit. The inclusion of the stock of fixed capital has not improved estimates, with the number of countries with null or negative relationship increasing relative to the case without capital stock. For pooled data, a lack of a discernible relationship can be observed for the profit rates including the stock of fixed capital. As intriguing as the correlations can be per se, some panel data tests with controls used before in the connected literature were also performed, evaluating the robustness of the results. The paper presents the theoretical reasons for the positive relationship between the interest and profit rates building on the branch of Sraffian literature known as monetary theory of distribution, as well as a tentative explanation for the emergence of this regularity only for the world as a whole.

Drivers of mutual content (production and ownership) in Chinese, EU, and US production

Topic: Trade and Global Value Chains Policies
Author: Oscar LEMMERS

Policy makers are increasingly recognising the vulnerabilities in relying on other countries for essential products such as food, energy and medicines. The Japan earthquake and subsequent tsunami of 2011 had sizeable immediate consequences since producers had only limited substitutes for supply from Japan. The COVID-19 pandemic brought attention to export bans on crucial items like medicines and face masks. Later, Europe’s dependence on Russian natural gas became clear.

Traditional analysis focuses on the countries that produce in a given global value chain (GVC), revealing possible bottlenecks. The government of a producing country may exert influence over the supply chain via trade. Governments may also influence supply chains via foreign investments. Suppose firms from country A own firms in country B that produce for country C. By exerting influence, the government of country A might affect the supply chain of country C. It is therefore relevant knowing firms from which countries own part of your supply chains. Many countries already implemented screening frameworks for foreign investments in their domestic critical infrastructure and technologies. However, they do not collect information about ownership in the supply chain.

The novelty of the paper is performing GVC analysis based not only on the country of production, but also on the country of ownership of production. It allows answering several research questions. For example, how much production in a given industry in a given country consists of value added produced in country A or produced outside country A under ownership of firms from country A? How does this involvement of country A develop over time? What are factors behind the developments and can they be influenced by policies?

This is illustrated with an analysis for the three major global traders, namely China, the United States and the European Union. First, it quantifies the value added embodied in production of one trader that was either created in the domestic economy of the other trader or under ownership of from by that other trader. For example, how much value added embodied in the production of EU car industry was created in China and how much of it was under Chinese ownership elsewhere in

the world. This uses standard input-output analysis. Second, the change during 2000-2019 is calculated. Third, factors driving these changes are calculated using a structural decomposition analysis. Some factors can be influenced by policies, such as direct imports and direct investments. Other factors, namely different trade patterns outside the own country/region, different investment patters outside the own country/region, general (de)fragmentation of GVCs and technological developments, cannot or only with great difficulties be influenced by policies.

The data for global value chain analysis are the input-output tables from the Asian Development Bank in constant prices. The data about ownership, by producing industry by producing country by country of ownership, are from the OECD AAMNE (Analytical Activity of MultiNational Enterprises) database.

An example of the results: USA related content in EU manufacturing of coke and petroleum products rose from 6.6 percent in 2000 to 10.2 percent in 2019. In the latter year, value added produced in the USA ultimately ending up in EU manufacturing of coke and petroleum products was 5.0 percent of total value added embodied in production for final use by this industry. Value added produced outside the USA under USA ownership amounted to 5.2 percent of the total value added embodied. The USA related content rose 3.6 percent during 2000-2019. This change was decomposed into factors. Changes in USA trade with the EU, USA ownership in the EU, and “the rest” amounted to 1.0 percentage point, 2.9 percentage point and -0.3 percentage point of the total change, respectively. Looking at other industries as well shows that the size of factors that can be influenced by policies is generally large.

Compiling bi-regional input-output tables for the Netherlands capitalising on existing data

Topic: Special Session: IDE-JETRO & Statistics Netherlands Joint Special Session
Author: Oscar LEMMERS

Dutch regions need to know how they are integrated in the domestic and global economy. Policies, such as the energy transition, are sometimes shifted from the central to the regional government. A useful tool supporting regional policies is a Dutch bi-regional input-output table. This shows the economic linkages between a region, the rest of the Netherlands and abroad.

We compiled bi-regional input-output tables for the Netherlands using existing statistics only. We did this for 53 regions, for the year 2018, maximally capitalising on existing micro and meso data. For the first time, such detailed tables are available for the Netherlands. It shows the value added of an NSI in the compilation process.

We regionalised national supply and use tables using regional production by industry. Then we patched supply and use together using data about links between a region, the rest of the Netherlands and abroad. Namely, trade in goods and services by enterprise (that can be linked to a region) and statistics about transports between regions, all at product level.

We use the data to answer several policy related questions. How much is a region dependant on abroad for inputs and sales? How much is a region connected to the rest of the country? Are there trickle-down effects of highly paid activities in a region? We find that for one euro of value added in the region Rotterdam, on average, there is 0.48 euro of value added in the rest of the Netherlands and 0.92 euro abroad. This is relevant for investment policies such as the Dutch National Growth Fund. To one job in high tech region Eindhoven (e.g., ASML), we show how many

jobs are related in the service sector in the same region. This is related to inclusive growth policies.

Intersectoral Technology Spillover and Its Decomposition Based on the Innovation Flow Matrix.

Topic: Financial analysis
Author: Chuan LI
Co-Authors: Xu JIAN, Jialu SUN

The economic system functions as a complex network, where interdepartmental production networks formed through input-output relationships constitute the underpinning framework for economic operations. Empirical research based on input-output analysis has shifted its focus from commodity trade connections to the spillover effects of innovation. However, existing studies often explain inter-sectoral innovation spillovers using endogenous growth models, with fewer models constructed from a general equilibrium framework. This study, grounded in an inter-industry patent citation network, constructs an innovation flow matrix and integrates it into an input-output analysis model to dissect technological spillovers at the industry level. Utilizing the compiled input-output table for the digital economy, the paper places special emphasis on analyzing the spillover effects of technological progress in the digital economy on traditional sectors and their decomposition. The research findings reveal that sectoral productivity effects are concentrated within their respective sectors, yet the digital economy exhibits noticeable innovation spillovers onto traditional sectors.

Measuring Global Value Chain Risks Based on the Absorbing Markov Model with Rewards

Topic: Input-Output Theory and Methodology
Author: Meng LI

In the intricate landscape of global economics, Global Value Chains (GVCs) have become central to our understanding of international trade and economic symbiosis. GVCs, functioning as complex networks for the production, assembly, and distribution of goods and services, encapsulate more than just economic efficiency; they are pivotal in a landscape teeming with diverse risks. The dense interdependence that typifies these global networks, a consequence of accelerated globalization, makes them especially susceptible to various disruptions. Geopolitical tensions, for instance, can trigger trade restrictions or resource nationalism, leading to supply chain disruptions and inflated costs. Energy scarcity, arising from resource limitations or geopolitical strife, can significantly escalate production expenses and cause delays, reverberating throughout the chain and impacting end-user prices and availability. Moreover, extreme climatic events can have the potential to halt production, devastate infrastructure, or impede logistics. In the realm of GVCs, a disturbance in one part of the chain can rapidly lead to cascading effects, resulting in substantial economic impacts that transcend national boundaries. Therefore, the precise measurement of these risks are crucial in ensuring economic resilience in a world that is deeply interconnected yet marked by uncertainty.

Substantial progress has been made in applying input-output models to quantify risks within GVCs. These studies have adopted innovative approaches, contributing to our understanding of GVC risk dynamics. Some researchers have focused on quantifying the impact of specific shocks,

analyzing how changes in volume and production due to events like natural hazards can affect GVCs. Another strand of research has employed techniques such as the hypothetical extraction method, centrality measures, and PageRank theory to identify the most crucial sectors within GVCs. By pinpointing these key sectors, these studies offer a way to understand which parts of the chain are most influential and, therefore, potentially more vulnerable to risks. There have also been attempts to quantify risks based on the frequency with which GVCs intersect with sectors deemed risky. As Inomata and Tanaka (2021) pointed out, a comprehensive risk assessment in GVCs should consider multiple aspects. In this study, we use a similar analogy, where the chances that a factory will be exposed to natural disasters (e.g., hurricanes) more badly because (1) a large amount of the factory's production is exposed to hurricanes; (2) the hurricane is more severe; or (3) the hurricanes happen frequently. This study aims to offer a novel method or a more comprehensive framework for quantifying risks in GVCs. Our approach integrates the volume of value-added/energy/emissions passing through the GVCs, the frequency and pathways of these flows, and the inherent risk strength of the country-sectors involved. By combining these dimensions, we seek to provide a more nuanced understanding of the multifaceted nature of risks in GVCs.

This study designed an Absorbing Markov Model with Rewards to trace the risks in GVCs. It employs the input-output table and integrates it with the absorbing Markov process to elucidate the flows within GVCs. The Markov process offers a sequential representation of production from a probabilistic perspective, enabling us to illuminate how production is organized step by step and capture how different countries and sectors are interconnected in production chains. To quantify the transmission of risks within these chains, the study utilizes a Markov Reward Process. In this method, risks are incorporated into the GVCs by assigning a "risk index" to each country-sector (or to each country-sector- country-sector pair), which can be understood as "rewards" related to each step of move in the supply chain. It also considers a discount rate to describe how risks penetrate/accumulate along the chains. This approach provides a method of quantifying how risks accompany the flow of goods and services, considering both the intensity and the propagation of risk factors. We apply this model to analyse risks from various starting states (the origin of the chains) or absorbing states (the final products of the chains), between specific starting-absorbing states bilaterally, and through complete pathways from staring state to absorbing state, passing through intermediate risky nodes. This general method makes it applicable to a wide range of aspects—whether analyzing the flow of value-added, energy, emissions, or other factors and how they pass through different key sectors (assuming the risk index to be identical), or analysing the multi-perspective risks, e.g., climate change risks, natural resources scarcity risks, geo-political risks, socio-economical risks, and etc. Thus, this study could offer both theoretical and practical insights into the realm of global supply chains.

Global household methane inequality

Topic: Input-Output Theory and Methodology
Author: Ruoqi LI
Co-Authors: Yuli SHAN, Yuru GUAN, Miaomiao LIU, Jun BI, Klaus HUBACEK

Combating climate change and reducing inequalities are among the world's overriding goals in this century (SDG10 and SDG 13), and are closely interacting. Reducing inequalities in an emission-constraint world requires an in-depth understanding of Greenhouse Gas (GHG) footprints from different groups of populations worldwide.
Previous research has extensively explored carbon dioxide (CO_2) inequalities of different households between and within countries. However, knowledge of methane (CH_4) inequalities

remains quite limited so far. On the one hand, CH4 possesses a strong global warming potential (GWP), which is more than 80 times greater than CO2, over its shorter lifespan. Therefore, targeting CH4 inequality reduction, lifestyle changes may curb the contemporary temperature rise more efficiently and effectively. On the other hand, CH4 emissions primarily stem from the production and transportation of oil, natural gas, coal, and agricultural activities, which is different from CO2 emissions that are dominated by energy combustion and manufacturing. This implies that previous conclusions from GHG (dominated by CO2) may not apply to CH4. Recently, several studies discussed the CH4 footprints of different countries and disparities within a single country. However, less is known about household-level CH4 inequalities at the global scale. In this context, this paper addresses the following question: What are the inequalities in CH4 footprints among various income groups in different countries and globally?

For the above purposes, we estimate the CH4 footprint of different household expenditure groups, by capturing consumption patterns across groups and countries at a high level of detail and linking it to our newly developed global environmentally extended multi-regional input-output (MRIO) model EMERGING (full-scale, near real-time multi-regional input-output table for the global emerging economies). The expenditure data in unprecedented detail is based and further adapted from the World Bank Consumption Dataset (WBCD), which distinguishes the consumption of 23,316 population groups (i.e., 201 expenditure groups in 116 countries, covering 87% of the global population). We obtain the CH4 emission data from EDGAR (Emissions Database for Global Atmospheric Research). By combining the fine-grained consumption data and the latest full-scale MRIO model, this study evaluates all economies (particularly emerging ones) based on country-specific data rather than introducing additional assumptions to split emerging countries from the corresponding region. Therefore, the emission inequalities quantified here are more comprehensive, detailed, and accurate than in previous attempts.

Our results indicate significant inequalities in global CH4 inequalities from households. In 2019, the top 1% expenditure bin induces 8% of the worldwide household CH4 emissions, equivalent to the total emissions caused by the bottom quarter. The per capita household CH4 of the richest 1% (277 kt) is more than 80 times higher than that of the poorest 1% (4 kt). The overall Gini index for CH4 inequality is 0.47, which is 33% higher than the average Gini income index in the same year, as reported by the World Bank. Supply-chain emissions induced by purchasing motor vehicles hold the highest inequalities among all types of household expenditures. The top 1% expenditure group is responsible for 24% of household emissions related to motor vehicle production, while the bottom 1% contributes only 0.02%. As a necessity, food consumption shows the lowest level of household CH4 inequalities among all expenditures, yet its Gini coefficient is still as high as 0.42. Notably, the key consumption categories we identified here differ from those in previous CO2 studies. For example, CH4 inequalities of transportation consumption rank top 3 among all expenditures, whereas it is among the bottom 3 expenditures in terms of carbon inequalities.

We further introduce the Theil index and decomposition approach to distinguish CH4 inequalities between and within countries. Our results show that variance in CH4 across expenditure groups (i.e., within-country inequalities) is greater than between countries, contributing over 62% of the overall CH4 inequalities. The major contributor to CH4 inequalities starkly contrasts with CO2, where the between-country inequalities play a dominant role due to the influence of different energy mixes in different countries. At the national level, within-country CH4 inequalities generally increase with a country’s development. On average, CH4 inequalities in high- and upper-middle-income countries are threefold to those in low- and lower-middle-income countries. Each high-, upper-middle-, lower-middle-, and low-income country is, on average, responsible for 0.7%, 0.8%, 0.2%, and 0.3% of the total CH4 inequalities. Our findings may provide insights into ongoing debates on efficient and fair climate policies.

Do China’s state-owned enterprises promote their suppliers’ participation in global value chains?

Topic: YSI and Development Programme V (Discussant: J. Rueda-Cantuche and B. Los)
Author: xin LI
Co-Authors: Wenyu DING, Ge XINQUAN, Shengyi XU, Yongming HUANG

China’s state-owned enterprises (SOEs), which maintain close ties with private business, play an important role in facilitating the effective connection between domestic and global value chains. However, how SOEs affect the participation of their suppliers in global value chains (GVCs) has not been sufficiently investigated. This study departs from previous work by investigating the impact of SOEs as customers on their suppliers’ participation in GVCs utilizing an unbalanced panel data, which involves 6011 samples from 1341 A-share listed firms in China during the period of 2008 to 2016. The panel data is based on matched dataset sourced from China Stock Market & Accounting Research Database (CSMAR) and Chinese Customs Database, along with the data of top five customers disclosed in listed firms’ annual reports which are manually collected from enterprise credit websites. The results indicate that SOEs significantly contributes to their suppliers’ participation in GVCs, of which the underlying causes are the stability and leadership of SOEs in supply chain partnerships. In addition, we find that both the degree of resource misallocation and the cost of supply-demand coordination have a negative moderating effect. Through suppliers’ heterogeneity analysis, it is found that the promotion effect of SOEs is especially noticeable when their suppliers are in a competitive market or serve cross-industry enterprises, while less noticeable when their suppliers also serve micro and small-sized enterprises or innovative enterprises. Furthermore, deploying the GVC position index to examine the impact of SOEs on their suppliers’ position in GVCs, we find that SOEs help enhance GVCs position which their suppliers locate in. The study’s findings highlight the leading and facilitating role of SOEs in promoting their suppliers’ participation in GVCs, and offer insightful implications for policies to balance security and openness.

Trade activity related to the multinational enterprises and its impact on vertical specialization

Topic:
Author: Xinru LI
Co-Authors: Kunfu ZHU, Xuemei JIANG

International division experienced a continued refinement from inter-industries division, intra-industries division, intra-products division to factors division. As the international flow of production factors increases frequently since the 1990s, factor division has become the essential feature and operational logic of current economic globalization. international investment is one of the main forms of international flow of production factors, which can not only promote the global allocation of factor resources, but also promote and replace international trade. According to the UNCTAD statistics, trade activities related to multinational enterprises (MNEs) account for about 80% of global trade. Under the background of trade and investment integration and the perspective of Global Value Chain, this paper incorporates the heterogeneity of MNEs into the trade accounting framework proposed by Koopman et al. (2014) and Wang et al. (2015), and further identifies the value-added in trade and vertical specialization related to MNEs. Research shows that about 32% of the domestic value-added in trade and 47% of the foreign value-added in trade were related to MNEs in 2019, an increase of 4 percentage points and 7 percentage points respectively compared to 2005. The impact of MNEs varies with income levels. Taking

China and the United States as examples, the impact on Chinese exports is higher than that on US exports. About 36% and 49% of domestic and foreign value-added in Chinese exports were related to the MNEs in China in 2019, a decrease of 9 percentage points compared to 2005. Domestic and foreign value-added in US exports related to the MNEs in US accounted for 21% and 78% in 2019, respectively, an increase of 7 percentage points and 30 percentage points compared to 2005.

Structural Effects of Trade Imbalances: an Input-Output Analysis

Topic:
Author: Pablo R. LIBOREIRO

Purpose - The coincidence in many emerging-market countries of trade surpluses and high growth rates has suggested the hypothesis that positive trade imbalances have effects on the economic structure that have a positive impact on growth. Specifically, it is assumed that trade surpluses positively influence the share of the manufacturing industry in the domestic product, due to the greater tradability of manufactures, and the return of physical and human capital, due to the different factor intensity of the tradable and non-tradable sectors. It is sometimes assumed, additionally, that both effects are greater in developing than in developed countries due to lower tradability of services and greater technological disparity between tradable and non-tradable sectors in less-developed countries. The present study aims to contrast such hypotheses by means of input-output analysis.

Methods & Data - To this end, an input-output model with a Ricardian flavour is developed in which good and factor prices are determined endogenously. The model can be easily calibrated from data contained in conventional IOTs, so that it can be applied to a large set of countries and years. In fact, the present study uses the data collected in the WIOD and obtains estimates for 40 countries in the period 1995-2009, in which important trade imbalances are observed.

Fidings - The results of this study show that: 1) in all countries in the sample, a positive trade balance implies an increase in the share of manufacturing industry in GDP; 2) in most countries in the sample, an increase in the trade surplus implies an increase of the profit rate and/or skill premium. 3) the structural effects of trade balances do not seem greater in developing than in developed countries.

Implications - The conclusions of this study have policy implications. Specifically, the results obtained seem to provide evidence in favour of the recommendation of positive trade balances in developing countries because the assumed structural effects are consistent with empirical observations. However, this policy recommendation has the serious flaw that the positive effects of trade surpluses in some countries coincide with the negative effects of trade deficits in other countries, as the structural effects of trade imbalances are similar in countries with different levels of income per head.

Novelty - The novelty of this work is twofold. On the one hand, an input-output model with a Ricardian flavour is proposed that can be solved exactly by conventional numerical methods and that allows the basic Leontieff model to be extended for the case of an open economy. On the other hand, the present study provides evidence in relation to a hypothesis of some importance for growth economics and which, from time to time, reappears in theoretical debates with policy implications.

Factor Price Differentials: Empirical Evidence from WIOD

Topic:
Author: Pablo R. LIBOREIRO

Purpose – In both developed and developing countries, there are large sectoral differences in the remuneration of production factors. These factor price differentials may be due to institutional distortions or market failures: in any case, they reflect imperfect sectoral mobility of production factors and, therefore, they are assumed to have negative effects on welfare, efficiency and growth. Furthermore, it is assumed that these effects are greater the lower the income per head of the countries and that, in fact, part of international differences in income levels can be explained by the lower sectoral mobility of production factors in less-developed countries. However, to date, there is little empirical evidence in this regard, given the scarcity of empirical studies that consider a large sample of countries and years. The present study aims to alleviate this gap by resorting to input-output analysis of the WIOD database.

Methods & Data – To this end, a small computable general equilibrium model is developed, which can be easily calibrated from data obtained in conventional IOTs so that it can be applied to a large set of countries and years. In fact, the present study uses the data collected in WIOD for four factors of production – capital, high-skilled, medium-skilled and low-skilled labour – and 40 countries in the period 1995-2009.

Findings – The results of the present study show that: 1) for almost all countries, the imperfect sectoral mobility of production factors has negative effects on real income; 2) a negative correlation is observed between the effects of imperfect factor mobility and income per head; however, the observed correlation is lower than generally assumed because of the low sectoral mobility of capital in developed countries; 3) in almost all countries, sectoral immobility of production factors positively affects the share of the manufacturing industry in domestic product; an additional cause of deindustrialization is thus discovered.

Novelty – The novelty of the present study lies in the fact that it empirically investigates the relationship between economic development and sectoral mobility of production factors, finding results that partly reaffirm and partly contradict the usual theoretical assumptions of the literature.

The structuralist theory of ‘Dutch Disease’: some numerical results for Chile

Topic: Input-Output Analysis
Author: Pablo R. LIBOREIRO

Purpose — By means of a practical model, the paper discusses the structuralist theory of the so-called Dutch Disease, which is based on the existence of conflicting claims to product among distinct sectors in a situation of lagging supply of key intermediates

Methods & Data — The model is for the Chilean economy and follows a Kaleckian ‘fix-price/flex-price’ structure, with 33 production sectors. Once calibrated and parameterized, the model can be solved numerically to estimate the effects of mining activities on other production sectors.

Findings — Some results follow from the numerical exercises. Mining-induced cost-push effects are biased against manufactures, while mining-induced demand effects are biased in favour of services. Therefore, high levels of mining activity led to a lower share of manufacturing in income as well as a lower volume of exports of non-mineral goods. However, it cannot in any case be taken for granted that mining will have crowding-out effects on manufacturing output.

Implications — The numerical exercises show a link between infrastructure services and mining-induced cost effects, which points to the crucial importance of infrastructure policy in mineral exporting countries. Results also show that the proposal for ‘achieving economic diversification by restricting mining’ – although tempting – may not work.

Novelty — The present study contributes to the literature on Dutch Disease by illustrating the order of magnitude of mining-induced demand and cost effects. These competing effects have been postulated theoretically by structuralist scholars but have not to date been estimated in practical models.

Profit Rate, Labour Exploitation and Foreign Trade: a 'Marx-Ricardian' Approach

Topic:
Author: Pablo R. LIBOREIRO
Co-Authors: Fahd BOUNDI

Purpose – The relationship between foreign trade and income distribution is usually analyzed using general equilibrium models that are based on the neoclassical theory of factor proportions. However, this is not the only possible approach to the problem: classical economics' theory of value as originally developed by Ricardo and others also allows a quantitative approach to the topic.

Methods & Data – In the present study, the classical theory of value as formalized by Morishima is assumed, in order to estimate the effect of foreign trade on the value of reproduction of the labour force and, therefore, on the wage-profit schedule. To this end, the amount of labour embodied in the means of reproduction of the labour force is estimated taking into account foreign trade: either considering the amount of homogeneous labour embodied in the exports needed to get wage-goods from abroad, either considering the amount of homogeneous labor embodied in imported wage-goods. To get some figures, use is made of WIOTs compiled in WIOD considering 43 countries and 15 years.

Findings – The results of this study show that, for almost all the countries in the sample, foreign trade reduces the value of the means of reproduction of the labour force, thereby allowing a higher profit rate. Only for a few developing countries (China, Indonesia, India) does the effect seem to be the opposite.

Implications – The results of the present study have policy implications. Indeed, the figures show that, in an open economy, a decrease in the labour share may not imply an increase in the rate of labour exploitation; actually, it may be the effect of a change in the terms of trade. Thus, it seems possible to reduce the exploitation of labour without affecting the rate of profit much by taking advantage of trade specialization.

Novelty – The novelty of the present study lies in the fact that it is one of the first studies that

analyzes - taking into account a large set of countries and years - the relationship between foreign trade and income distribution as proposed by the classical theory of value. Additionally, the present study also proposes a method to measure the use of production factors worldwide in homogeneous units.

PARANÁ BRAZILIAN STATE IN THE GLOBAL VALUE CHAIN: CARBON DIOXIDE EMISSIONS

Topic:
Author: Ricardo Luis LOPES
Co-Authors: Raoni Felipe de Almeida ANDRé, Carlos Alberto GONçALVES JUNIOR, Umberto Antonio SESSO FILHO

The globalization of production and trade has reshaped the dynamics of the world's economic interactions, particularly influencing the discourse on air pollution. Discussions about air pollution now transcend national boundaries and extend to global levels, given that industrial activities are dispersed across diverse sectors and regions. This dispersion results in the generation of air pollutants throughout the supply chain, spanning various locations globally.
Economic literature increasingly emphasizes exploring the nexus between trade relations, carbon dioxide (CO2) emissions, and the global value chain (GVC). In this context, a focal point of interest is the state of Paraná, which exhibits substantial integration with the world economy, primarily driven by its commercial ties with other Brazilian states through agricultural and agro-industrial production in its interior and the transformation industries in the metropolitan region of Curitiba.
The input-output matrix (MIP) is a common analytical tool for scrutinizing productive structures' interconnections across different countries and regions. This study constructed a comprehensive MIP to elucidate the flow of goods and services between the 27 states of Brazil and 64 other countries, including a category representing the rest of the world. This involved integrating the Brazilian inter-regional input-output matrix (interregional MIP) with the global input-output matrix (OECD). Brazil's information in the global MIP was replaced with data from Brazilian states in the inter-regional MIP. The export and import values of the 27 Brazilian states were estimated concerning the 64 countries and the rest of the world.
The research aimed to ascertain the significance of the GVC in CO2 emissions resulting from fossil fuel combustion in Paraná, considering intra-national trade with other Brazilian states and international trade partnerships. Findings indicated that Paraná emits a larger volume of CO2 in the sale of products to other Brazilian states than in exports to foreign partners. Notably, the state of São Paulo played a pivotal role, causing the Paraná economy to release approximately 3.28 million tons of CO2 into the atmosphere to meet its demand for intermediate products. This influence is attributed to São Paulo's economic magnitude (largest Brazilian GDP) and geographical proximity, facilitated by robust transport infrastructure connecting the productive structures of the two states.
In the realm of international trade, China emerged as the primary contributor to CO2 emissions in Paraná, accounting for around 0.57 million tons incorporated into Paraná exports. China is the foremost international partner trading with Paraná with its highly integrated global production chains. Additionally, OECD countries exerted a substantial impact, generating approximately 0.80 million tons of CO2 in Paraná's productive structure through their demands.
Lastly, within the context of final consumption, states in the Southeast and South of Brazil were identified as the major contributors to CO2 emissions within Paraná's economy. São Paulo, in particular, played a significant role, producing around 2,978 thousand tons of the pollutant within Paraná's productive structure. OECD countries also featured prominently, contributing

approximately 1,133 thousand tons of CO2 in producing goods and services destined for final consumption in Paraná. Regarding regions influencing the CO2 consumption for final demand in Paraná, São Paulo, and China were highlighted as the principal contributors, producing around 3,267 and 1,805 thousand tons of CO2 to meet Paraná's final consumption requirements.

Keywords: international trade, input-output model, CO2 emissions

JEL CODE: C-67, D-57, Q-56

Capital- and finance-based environmental accounting framework

Topic: Industrial Policies
Author: Luis A. LOPEZ
Co-Authors: Manuel TOMáS

Achieving the goals of the Paris Agreement will require significant investment to replace the current capital stock with less carbon-intensive alternatives. The success of this transition depends largely on the actions of capital owners who control the production process and can direct investments towards cleaner technologies. However, such investments and the production process often require feasible third-party financing.

In this context, we propose a new environmental accounting framework that distributes the responsibility for the environmental impacts of economic sectors between capital owners and the financial system based on the sectors' debt-to-asset ratio. For example, if this ratio is 0.4 for a sector, 40% of its assets are financed by third parties and therefore 40% of its emissions can be allocated to the financial side, while the remaining 60% can be allocated to the sector's capital owners. We apply this environmental accounting framework to the Spanish economy. First, we calculate sectorial capital- and finance-based emissions accounts according to the sectors' debt-to-asset ratio. The capital- and finance-based emissions intensities are fed into an environmentally extended multi-regional input-output model to calculate environmental responsibilities according to the production and consumption criteria, but differentiating between which part of environmental responsibilities is linked to the sectors' net worth, and therefore to its owners, and which part is linked to debt, and therefore to the financial system. Data used comes from the FIGARO database and environmental satellite accounts. We apply the methodology proposed for the Spanish economy, and therefore, we use sectorial debt-to-asset ratios from the Central Balance Sheet Database of the Bank of Spain.

This work extends prior applications that have calculated the environmental responsibility of specific financial institutions according to the criteria developed by the Task Force on Climate-related Financial Disclosures (TFCD, 2021). However, our contribution is that we present indicators of environmental responsibility based on capital and finance for all economic sectors consistent with the national accounts. Furthermore, the framework allows us to go beyond the current literature on production- and consumption-based emissions, where emissions are allocated based on production transaction flows. Our proposal allocates these responsibilities between owners and lenders based on economic sectors' financial balance sheet stocks and production transaction flows.

FIGARO-REG: a subnational Input-Output framework to expand the knowledge about regions

Topic:
Author: Jorge M. LOPEZ-ALVAREZ
Co-Authors: Luis PEDAUGA, José M. RUEDA-CANTUCHE

The requirements of water to feed a megacity: explorations for Mexico City with a multi-regional input-output database

Topic: Sustainable Production and Consumption Policies
Author: Carlos Andres LOPEZ-MORALES

The continued urbanization process characterizing the global economy challenges the adequacy of consumption patterns with respect to the conditions of ecological sustainability, already deeply compromised in the 21st century. In particular, the satisfaction of the urban demand for food usually requires complex supply chains spanning large distances and involving several industrial activities, from large-scale agriculture and food processing to retail and several kinds of services for food preparation. Global agriculture famously claims about 70% of the global demand for water and has been described accordingly as the strongest driver for stress and scarcity of the world's water. This dynamics, however, is only a response to the complex task of satisfying the particularities of consumption patterns of an increasingly urban global population. Therefore, any promotion of water sustainability requires a sound understanding of the links between water demand and availability, food production, trade, and consumption patterns of increasingly urbanized economies.

This paper explores these links for the case of Mexico City and the Mexican economy. Housing 22 million people, the metropolitan area of Mexico City is the world's fifth largest, and satisfying its food demand requires a productive effort of macroeconomic scale. The paper estimates the national demand of water associated with this productive effort. To do so, the paper first defines Mexico City's demand for food products and estimates both its magnitude and its distribution across the 32 Mexican states. That is, the exercise first represents the urban demand for food in an input-output model by selecting the relevant activities in the Mexican industrial classification, which is also used in North America and very similar to international standards. Then, it describes the national supply chains that become active to generate the required output, and estimates its water requirements at the state level. This procedure allows to not only provide an aggregate figure for the volume of water required to satisfy the city's food demand, but also to distinguish the places of origin at the state level within Mexico. Finally, to assess whether these water requirements contribute to local scarcity, the paper looks at their relationship with the local situation of water availability or stress.

In terms of methodology, the paper features an environmentally-extended input-output computation with a multi-regional input-output (MRIO) database defined for Mexico's 32 states. Recently produced by the Mexican office for statistics, this database describes the structure of the Mexican economy as of 2013 at the state level with 79 products. To account for the urban scale, the paper benefits from the definition of Mexico City as one of the country's states in the MRIO, although it adjusts the database to include the neighboring municipalities that complete the metropolitan area. The environmental extension of the MRIO consists of data from Mexico's water agency estimating the water requirements for each of the 79 products in each of Mexico's states, and data also describing the economically relevant availability of water. Finally, the paper

discusses the possibilities and the limitations of Mexico's new multi-regional database to describe the links between water, food and cities with a standard application of input-output methods.

Understanding the Technological Structure at the Local Level: A Social Accounting Matrix of Milpa Agriculture in the Huasteca Veracruzana, Mexico

Topic: Regional Analysis
Author: Carlos Andres LOPEZ-MORALES
Co-Authors: Miriam BOYER

The multifaceted challenges facing the global economy in the 21st century demand a comprehensive understanding of production technologies, particularly regarding the conditions of ecological sustainability and its social implications. For some decades, input-output economics has been a fruitful approach for understanding the technological structure of an economy, with theoretical and empirical developments that can analyze the economic implications of technological choice, either with comparative studies or with scenario analysis. These approaches are largely based on the representation of technologies through their input structures, which in turn operate in the associated economic model as a determinant for both cost and price. This analysis has been expanded to include income distribution and institutional arrangement with the expansion of input-output tables into social accounting matrices (SAMs), constituting a practical way of empirically representing the social dimension of the economy's technological structure. However, whereas historically the empirical development of SAMs has been dominated by applications at the national and regional scales, the local level has been largely underrepresented in the literature.

This paper reports on the construction of a social accounting matrix for a local economy to study the ways in which a particular community articulates its social reproduction through its technological structure. The local economy is constituted by four peasant communities dependent on small-scale, community-based Milpa agriculture in the mountainous huasteca region of the Mexican State of Veracruz. The indigenous population in these communities faces several challenges ranging from high levels of poverty, lack of economic opportunities, migration, and climate change. We investigate the extent to which traditional agriculture based on Milpa technology is able to guarantee the basic conditions of subsistence. We report on the results of a field study conducted in these communities to construct a survey-based social accounting matrix that illuminates the strengths or weaknesses of their internal economic interactions, and the nature of their relation to the economic system beyond the community.

Methodologically, this exercise makes three contributions: First, it offers a case of study for constructing a SAM at the local level via the application of a survey. Second, SAMs work both as an economic model (in this case, of income distribution) and as a database (depicting the circular flow of income), allowing us to investigate how their economy-wide scope and consistent methods can be of use for understanding of the social implications of production technologies, even at the local level. Third, it explores the possibilities of SAMs for contributing to social life-cycle analysis (S-LCA), an approach that has been developing recently for assessing the social impacts of goods and products across their life cycle. As has been recognized, LCA has benefited largely from the comprehensiveness of input-output tables. We assess that the social aspects analyzed in S-LCA can be easily included in the construction of a SAM.-The latter not only includes the technological structure of an economy like an input-output table would do, but also describes the interactions between technologies, factors of production (i.e., labor and capital), and the

institutions to which they associate (i.e., firms and households).

Do long-distance value chains imply lower unit labor costs?

Topic: Trade and Global Value Chains Policies
Author: Bart LOS

Due to, among other things, geopolitical frictions and a stronger notion by multinational firms that spreading activities over the world imply risks, "deglobalization" is currently a buzzword in the press and among policymakers. The same goes for terms like "nearshoring" and "friendshoring". In discussions about these phenomena, the previously attained gains associated with the international fragmentation of production processes (in Global Value Chains, GVCs) often appear as of secondary interest at best. The fact that GVCs emerged suggests that it was profitable for firms to relocate many of their activities. Cheap labor in e.g. Asian countries has often been viewed as the main reason for these relocations.

In this paper, we quantify the relationship between unit labor costs of the output of GVCs and the distance covered by value added within such a GVC. Given that long distances imply high transportation costs (and often risks), we hypothesize that a negative relationship exists. We use a panel data approach. All data are taken from the WIOD-2016 release. Unit labor costs in a GVC are computed using variables related to labor compensation, using standard assumptions in input-output analysis. For the distance variable, we develop a variant of the "supply chain fragmentation" measure introduced by Timmer et al. (2021, IMF Econ Rev), combining this measure with data on geographic distances from CEPII's gravity database (Conte et al., 2022). This variable does not only cover the number of times products cross borders within a GVC, but also how far these products travel. The average distance traveled by a dollar of value added vary considerably over types of GVCs. Preliminary results show that (averaged over 2000-2014 and over countries-of-completion, i.e. the countries in which the last stage of production takes place) this distance was about 1800 km in GVCs for electronics and less than half of this in GVCs for food products.

Preliminary results also show that the unit labor costs of GVCs tended to decrease with increases in the distance variable, which would lend empirical support to our hypothesis. Importantly, the preliminary results show that this effect is much stronger for GVCs producing electronics, transport equipment and machinery than for GVCs producing textiles and clothing. It should be stressed, though, that these are preliminary results and that several additional specifications of both the main explanatory variable and the regression equation have to be tested.

How and why we detail household final demand to cover multiple household activities

Topic: Sustainable Production and Consumption Policies
Author: Sofia Topcu MADSEN
Co-Authors: Bo P. WEIDEMA

Input-output analyses are increasingly used to estimate consumption-based environmental footprints, driven by a need for demand-side climate change mitigation approaches. For instance, several input-output analyses have distinguished different household income or geographic segments and estimated the climate footprint associated with their consumption across different

final demand categories, such as food or transport. While these studies show who drives the total consumption and their environmental impact per $ or kg consumed, it is equally important to show how the households consume and their emission per minute spent in an activity. A growing body of research has emerged in recent years, shedding new light on the environmental impacts of how people consume by linking the environmental footprint from input-output analyses with household activity patterns obtained from time-use surveys. The current study goes a step further and demonstrates how household activity patterns can be integrated into the input-output structure and why it is important.

The current study aims to develop an input-output structure detailing the use of market and household-produced products in household activities that can be used to calculate the climate footprint associated with a minute spent in household activities like eating or reading. As a start, it collects relevant data from the United Kingdom, Denmark, and the United States. It demonstrates that the developed set of methods is relevant and valid across the three countries. The methods will be used to detail the final demand in a multi-regional environmentally extended input-output table developed in the project called “Getting the Data Right” led by researchers at Aalborg University (https://www.en.plan.aau.dk/research/the-danish-centre-for-environmental-assessment/getting-the-data-right). Method-wise, the study is inspired by an area of research earning recognition in the 1990s integrating household production into input-output tables to estimate total production in the economy and disparities in the sphere of production (market and household) between men and women. Household production activities resemble market activities; one could pay a third person to perform them without loss of utility. Activities like meal preparation, cleaning, and childcare are household production.

The study uses time-use diary data and household budget data from the relevant countries to detail the final demand for the most recent available years. Further, it uses energy, water, and other end-use data sources to enable the distribution of products to household activities. The study details households by their equivalized income and household composition. In the case of the UK, 33 household groups were created, each described by their income and composition. The groups are representative of the UK population and represented in the time-use survey and household budget survey. For each household group, a household supply and use table is created with household production activities as the rows and columns. Household-produced products are valued based on the price of an equivalent market product. The use table includes additional columns for the household final consumption activities, such as eating, relaxing, or exercising. Household production activities, including secondary production, provide inputs to other household production and final consumption activities. Products are distributed based on end-use data, a priori reasoning, and a time proportionality principle. This is used to create a household input-output table for each household group which is used to distribute the final demand vector to household groups and activities. An account of time use during the entire day, including during market work time, is included for each household group.

When used to detail the final demand in the input-output database, the methodology can be used to generate novel results in that it allows an integrated analysis of the economic, environmental, and social spheres. For instance, the simultaneous effect on emission levels and consumption inequality from a policy change can be estimated. Results can inform policymakers about whether targeting the structure of household activity patterns or the consumption during an activity is most relevant to mitigate climate change. Opposed to the recent studies on the topic, the outputs of household production activities are allocated as inputs to final consumption activities. Thus, the calculation of total expenditures and the associated environmental footprint of the final consumption activities include the household-produced inputs.

Global supply chain restructuring towards achieving a low-carbon procurement of mineral resources

Topic: Trade and Global Value Chains Policies
Author: Keitaro MAENO
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While mineral resources play an essential role to achieve a decarbonized society, their production processes are highly CO2 intensive. For mitigating climate change, it is important for industries worldwide to reduce CO2 emissions from productions of mineral resources which are embodied in their production activities including global supply chains (GSC). Several previous studies have revealed the current situation and the future transition of CO2 emissions from mineral resource productions; however, they did not answer the important question: How can industries improve the mineral resource procurement structure in their GSCs to reduce CO2 emissions? To address this research question, this study aims to propose an input-output (IO) analysis framework to investigate impacts of a structural change in the mineral resource procurement of GSCs induced by final demands in a specific country (i.e., GSC restructuring) on global CO2 emissions.

First, this study built a unit-hybrid multi regional IO (MRIO) table using the GLORIA database in 2019 which covers 120 sectors in 164 countries/regions and industrial material use data for mineral resources in its satellite account. Specifically, the unit-hybrid MRIO table describes elements for the specific sectors related to mineral resources in physical values (tons), and ones for the other sectors in monetary values (USD). Second, this study applied the hypothetical extraction method: HEM (Dietzenbacher et al., 2019; Maeno, 2023) to the IO table to estimate impacts of hypothetical structural change of mineral resource procurement in industrial GSCs on their global carbon footprints. The novelty of this study is to model a GSC restructuring defined by extractions/substitutions of mineral resource productions in GSCs based on "physical value" by the first attempt of applying the HEM to a unit-hybrid MRIO table, enhancing a reality and feasibility of results obtained by the proposed framework.

For a demonstration of the framework, we conduct the case study focusing on the GSC restructuring of Japanese industries targeting iron ores produced in the top five producing countries (Australia, Brazil, China, India, and Russia) which account for more than 85% of the total production of iron ores in the world. Furthermore, to reflect a more practical situation, this study defines the GSC restructuring scenario at a small scale in which basic iron sector in each country included in the GSCs of Japanese industries shifts its trading partners from the targeted countries to other substituting countries for importing 0.1 kt intermediate input of iron ores per a unit of its outputs.

The results showed the changes in the trade flows of iron ores and CO2 emissions triggered by the relevant GSC restructuring in the small scale. Specifically, we found that the GSC restructuring targeting iron ores produced in China and India contributed to net CO2 reductions by -695.9 t-CO2 and -573.2 t-CO2, respectively. On the other hand, those targeting Australia, Brazil, and Russia had the positive impacts on the net CO2 emissions by +763.1 t-CO2, +257.2 t-CO2, +34.5 t-CO2. This result implies that when Japanese industries promote a structural change of iron ore procurement in their GSCs to reduce global carbon footprints, they should target iron ores produced in China and India. Furthermore, we decomposed positive or negative contributions of substitutions in each country to the net impacts of the GSC restructuring for iron ores produced in each targeted country on CO2 emissions, indicating an effective way for Japanese industries to reduce their global carbon footprints through the relevant GSC restructuring.

Finally, we highlighted the significance of the proposed framework with a comparison to the previous HEM model and concluded that our framework could offer valuable insights to policymakers in countries that depend on imported mineral resources as policy implications for designing effective trade strategies for industries in a relevant country to achieve a low-carbon procurement of mineral resources.

Recycling carbon taxes for reindustrialisation: addressing structural rigidity and financialisation in natural resource exporting countries

Topic:
Author: Guilherme Riccioppo MAGACHO
Co-Authors: Antoine GODIN, Danilo SPINOLA

The inclusion of developing and emerging countries in the low-carbon transition agenda is necessary to achieve climate goals, and policies must be designed according to their idiosyncrasies. Despite the relevance of these countries, their structural specificities are often overlooked in low-carbon transition models. With the aim of building a suitable framework for this analysis, this article develops a Structural Stock-Flow Consistent (Structural SFC) model for open developing economies, categorising production into three sectors: resource-based exports, non-tradable goods and services, and other tradable sectors.

Although SFC models are important for highlighting financial constraints, they are rarely multi-sectoral and fail to account for structural specificities. The contributions of our model are twofold: (1) it provides a versatile framework that captures varying country characteristics and balances short-term demand with long-term structural strategies, and (2) it demonstrates that sole reliance on carbon pricing is insufficient for economies anchored in carbon-intensive sectors.

By accounting for structurally different sectors in a truly monetary framework, the model allows us to understand how financial constraints derived from structural rigidities play a decisive role in determining the dynamics of the low-carbon transition. The model provides evidence that the effectiveness of carbon pricing depends on countries' commercial, financial and production structure. It also shows that carbon tax recycling is essential to avoid recessions and promote sustainable decarbonization by strengthening innovation and competitiveness in low-emissions industries.

Quantifying the trade drivers of planetary boundaries

Topic: Sustainable Production and Consumption Policies
Author: Guilherme Riccioppo MAGACHO
Co-Authors: Gabriel Santos CARNEIRO

This paper aims at understanding the limits outlined by the planetary boundaries in terms of global trade. The latest Planetary Boundaries update portrays an alarming global ecological situation in which six of the nine boundaries are transgressed. By identifying the processes that are critical for maintaining the stability and resilience of the Earth system as a whole, the framework equates a multi-level range of ecological dynamics. However, there are mismatches between the levels of the Earth System and social dynamics. As planetary boundaries are defined

at global level, it is not clear yet what their social drivers and implications are, especially in relation to a global economy that is structured around flows of trade between national units.

Global economic relations are structured around unequal patterns of ecological, productive and financial exchanges. Some countries are “nature suppliers” to the global economy, feeding natural resources and raw materials into global productive chains. On the other hand, there are countries that are mostly consumers of these products, exerting the demand that keeps the global economy operating. When different natural resources are observed, countries switch positions along a multidimensional spectrum. One country could be, for example, an exporter of “water” and an importer of “land” at the same time. Therefore, different countries and economic sectors contribute directly and indirectly by pressuringe/easing planetary boundaries through their commercial relations with other economies. The dynamics of cross-border global trade illustrates a dependence relationship, as the exports of nature generate income, jobs, fiscal revenues and foreign exchange that are crucial for the general macroeconomic picture of a country, while imports are essential for sustaining certain levels of well-being profited by society from the economic system.

In this paper we aim at analysing environmental footprints in global trade in order to understand which countries and economic activities (economic sectors) pressure each Planetary Boundary. Using the GLORIA environmental extended multi-regional input-output (MRIO) database constructed in the Global MRIO Lab, which accounts for 164 countries and 120 sectors, we calculate environmental footprints embodied in trade relations.

Drawing on the ecological variables employed in the original planetary boundaries works, we select key variables available in GLORIA’s satellite accounts to estimate separately the pressure exerted on each one of the six exceeded planetary boundaries. Land use is measured in terms of hectares used in production. Change in biosphere integrity is measured in terms of potentially disappeared fraction (PDF) of biodiversity loss. Climate change is measured in GHG emissions in kilotonnes. The global freshwater boundary is measured both with water stress and blue water consumption calculated in million m3 H2O equivalents. Nitrogen and phosphorus loading calculations are made by estimating the amount of embodied nitrogen and phosphorus measured in tonnes in agriculture sectors. Based on the suggestions made by Persson et al. (2022), the novel entities boundary is estimated through the amount of embodied non-energy materials employed in the chemicals sector.

Based on GLORIA’s environmental satellite accounts, we estimate the direct and indirect (embodied in domestic and imported inputs) pressure that countries’ final demand exert on the multidimensional spectrum of boundaries. These estimates allow us to identify embodied footprints on trade, and hence the countries that are “nature resources exporters” and those that are “nature resources importers” in different dimensions.
The novelty of this research lies in exploring in detail which economic sectors and countries are exerting more pressure over the planetary boundaries. The results indicate that there is a group of countries that plays an important role as resource suppliers, and another group composed predominantly of users of most resources. Nevertheless, there are also countries that are suppliers of some resources and users of others, which shows the importance of a multidimensional approach. Results also show that the pressure of global trade on each planetary boundary is linked to the production and trade in specific economic sectors.
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Main policy implications point towards the need of a stronger international cooperation on global trade that would address the economic activities that exert pressure on the different boundaries. While there have been some advances on global cooperation for environmental issues,

particularly with the recurrence of COP meetings, discussions on global trade have been in deadlock for a long-time. Our results show that avoiding planetary boundaries' overshooting requires the ecological issues and global trade to be addressed together.

FOREIGN TRADE, CAPITAL FORMATION AND INVESTEMENT IN THE ECONOMIC DEVELOPMENT OF MEXICO 1993 – 2020.

Topic:
Author: Marco Antonio MARQUEZ
Co-Authors: Fidel AROCHE

Since the 1990s, Mexico has transformed into a manufacturing-exporting country, including some with complex technologies; however, the rapid growth of this variable bears little relation to the overall expansion of the economy. Two concepts in structural analysis help study the limited relationship between foreign trade and growth in the Mexican economy: the investment multiplier contained in the value of exports and the capital formation multiplier contained in the value of exports. The amounts and the type of goods traded threaten growth as they inhibit investment or capital formation. This paper discusses multipliers and suggests measuring the effects of using domestic and imported inputs on growth, focusing on capital formation and capital stocks.

Circular Flow: The Effects of Supply and Demand on Growth Economic. A Comparative Analysis of Economic Structure of Mexico, Brazil, and Argentina.

Topic:
Author: Marco Antonio MARQUEZ
Co-Authors: Rodrigo ALIPHAT

The Input-Output model is based on the conception of the economic system through the analysis of the circular flow, which acknowledges that the production process is driven by demand, and its effects are iterative among economic branches or industries. Changes in the demand for a sector modify the level of output for the entire economy, as it causes direct changes in the output levels of other sectors to which it is connected as suppliers, and indirect changes to the suppliers of those suppliers. Each branch increases, in a constant proportion, the use of inputs and factors for each unit of output. However, it has been demonstrated that this type of production makes it impossible for intermediate demand to follow a fixed consumption pattern. Therefore, the supply model derived from the Input-Output tables is implausible and unstable. This research measures variations in the prices of the Leontief model and interprets that the price increase is due to technological transfer resulting from the effect of demand disruption. Such results demonstrate that, according to the model, the demand curve for each sector can be elastic, inelastic, or inverse to price. This study exemplifies these principles in the production structures of Mexico, Brazil, and Argentina.

Evaluating the GHG Reduction Potential through the Adoption of Electrified Kei Vehicles in Japan

Topic: Industrial policies
Author: Takayuki MASE
Co-Authors: Shigemi KAGAWA, Shunichi HIENUKI

To achieve the goal of carbon neutrality in Japan, there is an increasing expectation for further promotion of electrified vehicles, and numerous empirical studies on Life Cycle Assessment (LCA) for electrified vehicles have been conducted. It is important to note that when forecasting life-cycle CO2 emissions from electrified vehicles, researchers make assumptions about the lifetime mileage of electrified vehicles and the future electricity generation mix of a country. Therefore, there is uncertainty in both the lifetime mileage of electrified vehicles and the future electricity generation mix in previous studies. In addition, although the Japanese car market is characterized by mini passenger vehicles with an engine displacement of 660cc and below, commonly known as "Kei passenger vehicles," previous studies did not estimate the greenhouse gas (GHG) emissions reduction potential of promoting electrified Kei vehicles.

In this study, we make an environmentally-extended input-output table, taking into account the specific passenger vehicles technologies of electric vehicles (BEV(O)), hybrid vehicles (HV(O)), plug-in hybrid vehicles (PHV(O)), fuel cell vehicles (FCV(O)), and internal combustion engine vehicles (ICE(O)). And Kei vehicles also include electrified Kei passenger vehicles (BEV(K)) and Kei vehicles with internal combustion engines (ICE(K)). More specifically, this table reflects the different body structures of electric vehicles. For example, electrified vehicle sectors (BEV(O) and BEV(K)) eliminates the need for an engine compared to the combustion engine sector, while considering an increase in batteries and other electric machines. In addition, the electricity generation sector is further detailed with a focus on non-fossil generations such as renewable energy and nuclear power.

Next, we evaluate the life-cycle GHG emissions associated with the vehicle life-cycle, from manufacturing to disposal, assuming a wide range of electricity generation mixes. Scenario analyses are conducted to further evaluate the GHG reduction potential of introducing electric vehicles in two cases: decarbonizing the power supply and promoting the electrification of passenger cars. As for the power supply, three scenarios are presented, Case I (based on 2015 data), Case II (Japanese government's 2030 target as indicated by the Ministry of Economy, Trade and Industry in Japan), and Case III (zero emissions projected for 2050 by IEA). Additionally, four car electrification cases were examined: Case A (2015 sales figures with 35.9% kei passenger cars and others), Case B (100% BEV(O) sales), Case C (a mix of 64.1% BEV(O) and 35.9% BEV(K)), and Case D (100% BEV(K) sales). Assumptions included a car's lifetime mileage and differing energy efficiencies based on various factors. Disposal costs were estimated using actual recycling fees from leading car manufacturers.

Moreover, the overall objective of this study is to analyze the cost-effectiveness analysis based on scenario-specific marginal cost curves. The economic costs of BEV(K) are expected to be lower than those of BEV(O) , HV(O), PHV(O), FCV(O), and ICE(O) with lower greenhouse gas emissions. Finally, this study obtains policy implications based on these findings.

A Comprehensive Life Cycle Analysis of Old- and Next-Generation Ships

Topic: Sustainable Production and Consumption Policies
Author: Mami MATSUSE
Co-Authors: Shigemi KAGAWA, Ai NAGATA

The International Maritime Organization (IMO) revised its Greenhouse Gas (GHG) Strategy to achieve net-zero GHG emissions from international shipping by 2050. Following this global trend, Japan is also taking actions to reach this goal by introducing Liquefied Natural Gas instead of heavy oil as marine fuel and investing in steel ships operated by hydrogen or ammonia, which do not emit any GHG on board.

It is important to note that ship components (e.g., engine, fuel tank, and fuel supply system) vary in size and require different materials for construction. Consequently, the intermediate inputs necessary for manufacturing ships significantly affect the amount of CO2 emissions directly and indirectly induced by the manufacturing process. A previous study also discusses the feasibility of reducing onboard fuels by weight (Kim and Choi, 2023).

Few previous studies have analyzed the amount of CO2 emissions in the manufacturing process of ships with hydrogen- or ammonia-combustion engines. In a relevant prior study, Shi et al. (2023) emphasized the importance of the green fuel pathway in shipping, as well as the manufacturing of ships. They analyzed the cost of introducing renewable energy throughout the ship life cycle. To the best of our knowledge, there have been no previous studies addressing a comprehensive life cycle analysis of next-generation ships with hydrogen- or ammonia-combustion engines. The novelty of this study is the following. This study represents the first attempt to clarify the effectiveness of introducing eco-friendly fuel alternatives to heavy oil to decrease the amount of life-cycle CO2 emissions for a specific ship type and weight.

To calculate the amount of CO2 emissions from manufacturing a specific type of ships in Japan in 2015, we utilized detailed ship inventory data from the Ministry of Land, Infrastructure, Transport and Tourism, 2015 Input-Output Tables for Japan from the Ministry of Internal Affairs and Communications, and the 3EID database (Embodied Energy and Emission Intensity Data for Japan Using Input-Output Tables) from the National Institute for Environmental Studies.

The results show that the final demand for steel ships manufactured in Japan contributed to emitting 10 million t-CO2e of CO2. Breaking down the emissions based on ship materials, pig iron and electricity had the highest CO2 emissions, in that order, accounting for about 35% and 17% of the total CO2 emissions from ship manufacturing, respectively. This suggests that the amount of CO2 emissions could be affected if ship materials and components are changed due to fuel substitution.

Subsequently, based on the Statistical Survey Data on Coastwise Vessel Transport from the Ministry of Land, Infrastructure, Transport and Tourism, we calculated the amount of CO2 emissions from operating large and small ships, including cargo ships and oil tankers, in Japan in 2015. The results show that the amount of CO2 emissions was about 6.6 million t-CO2e to operate the ships in 2015. Based on these results, we found that the annual CO2 emissions per ship at the manufacture and operation stages were 320 t-CO2e and 49,000 t-CO2e for small ships, respectively. For large ships, the annual CO2 emissions per ship at the manufacture and operation stages were 13,000 t-CO2e and 103,000 t-CO2e, respectively. When comparing CO2 emissions between ship manufacture and operation, large ships emit 152 times more CO2 during

operation than during manufacture, while small ships emit 8 times more.

Importantly, we further found that next-generation ships with hydrogen- or ammonia-combustion engines have significant CO2 reduction potential throughout their life cycle. Thus, this study suggests promoting fuel substitution during operation while considering changes in CO2 emissions during ship production.

Loose coupling of engineering and interindustry models: benefits and pitfalls

Topic: Special Session: Integration of energy systems models and economic models: advances and applications
Author: Douglas S. MEADE

Loose coupling of engineering and interindustry models: benefits and pitfalls
Douglas S. Meade (Inforum, USA)

For many types of modeling analyses, it is helpful to link models of different types. When working with an input-output model, researchers may often link to a macroeconomic model. Other useful linkages include models of satellite accounts (R&D, travel and tourism, or health care, for example). Research on energy supply and demand, GHG and other emissions, new technologies and materials flows often involves detailed information at a finer level of detail than that generally available in an input-output based model. In addition, measurement and modeling in physical units is necessary. In this case, it may be fruitful to link an engineering and technology (E&T) model with the input-output model. An E&T model maintains a detailed energy system representation that captures the flow of energy and technology adoption and the satisfaction of end use demands. It has the ability to model detailed information about costs and characteristics of competing technologies that may be used to satisfy end use demands.

An interindustry model, on the other hand, whether it be econometric or CGE, can provide a consistent and fairly detailed picture of the overall economy, and relates to end use demands by consumers, businesses and government. Such a model can also incorporate forecasts of industry exports and imports, both for energy and non-energy sectors. If the model contains a macroeconomic block which includes national accounting (SNA) by institutional sector, it enables the modeling of policies that have implications for the government budget, including the modeling of revenue recycling mechanisms. An interindustry model can also capture the price effects of policies to reduce GHG and other emissions, including their indirect effects. The model also provides essential economic projections which are exogenous to the E&T model, such as household disposable income, sectoral prices, and interest rates.

This paper draws upon experiences gained in several studies that have been performed using the Inforum LIFT model loosely coupled with E&T models. Two prominent examples are the US MARKAL model, and the Energy Pathways model. We will review the objectives and benefits of coupling these models, and delineate their relative areas of specialization.

Some of the main topics explored include:
- How are the linkages between models established? What does the IO model provide to the E&T model and vice-versa?
- What are some of the issues in converting between monetary and physical units? Difficulties due to different product mixes (including geographical distribution), as well as

price-discrimination across markets, that belie the IO “one-price” assumption are important to consider.

- How can technology forecasting from engineering and R&D based projections be translated meaningfully to changes to IO coefficients. A particular example is the modeling of corn and cellulosic ethanol, and their blending with gasoline.

Finally, we will make recommendations on how such hybrid linkages could be improved, with an eye to suggesting changes in both the IO and the E&T models.

Industrial Value Chain Characteristics and Firm Financial Performance: Evidence from the US Stock Market

Topic:
Author: Bo MENG
Co-Authors: Larry LI, Lei LEI, Jiabai YE, Jiemin GUO

Industry-specific factors are known to have a significant effect on firm market performance. However, the comprehensive impact of value chain characteristics at the industry level on a company’s financial performance is not well understood. In this study, we use the US input-output datasets that cover 405 sectors and the financial database of listed companies in the US stock market from Refinitiv for the period of 2007-2021, to examine how industrial value chain position, length and complexity affect firms’ financial performance. Our results show that value chain features of the US domestic economy have a substantial impact on firm financial performance, and the marginal effect of value chain features at the industry level is more pronounced. Moreover, we find a U-shaped relationship between value chain features and firm financial performance, which is consistent across different models. Our significant results suggest that the value chain characteristics vary greatly across industries depending on the regulatory and industry context within a firm operates, suggesting that institutional environments can have profound effects on a firm’s performance. The robust relation between various value chain characteristics and firm performance offers practical guidance for investors making more rational investment decisions. Therefore, our findings might potentially offer new insights and guidance for stock market investors who want to make better decisions on industry-specific investment.

Which are the costs of rigidity? A General Equilibrium study of the fuel market in Argentina

Topic: YSI and Development Programme I (Discussant: S. Kagawa and R. Bardazzi)
Author: Juan Ignacio MERCATANTE

The most widely applied policy around the world regarding biofuels is the mandatory blend of fossil fuels and biofuels. This policy aims to induce the use of biofuels setting a minimum level of biofuel per unit of blended fuel. This paper studies the costs and benefits of this policy. To do so, it develops a Recursive Computable General Equilibrium model which runs between 2019 and 2030 and it is calibrated with an own-elaborated Social Accounting Matrix of Argentina for 2018. The research questions are: what are the costs and benefits of a mandatory blend compared to a full flexibility scenario? Is it better to induce the use of biofuels through a tax on fossil fuels or through the blending constraint? Which are the impacts of international price shocks in different blending regimes? Two scenarios are evaluated: (i) an increase in the international price of oil, and (ii) an increase in the international price of agricultural commodities. The contribution of this

paper is threefold. First, it contributes by assessing the cost and benefits that arise from the application of mandatory blends not only in terms of activity but also in terms of poverty, income distribution, and energy security. Second, this paper compares the performance of the mandatory blend with respect to a tax on fossil fuel. Third, this paper contributes by evaluating the impact of international price shocks under different blending regimes. Additionally, this works elaborates a Social Accounting Matrix for Argentina 2018 with an emphasis on energy which is a valuable database. This paper finds that the mandatory policy has a negative impact on economic activity, poverty, income distribution, and energy security and a positive impact in terms of emissions. An interesting result is that, in a flexible context, the economy ends up with a higher biodiesel blend than the initial one. However, this does not happen in the case of bioethanol. When analysing the convenience of a special tax on fossil fuels instead of a mandatory regime this paper finds that the benefits of each policy are distributed differently in time. The special tax on fossil fuels performs better in the short run while the mandatory blend does it in the long run. Finally, this paper finds that a flexible regime allows for cushioning the unwanted effects of different shocks on international prices.

Implementing the AfCFTA Agreement and implications for Africa’s regional value chains

Topic: Trade and Global Value Chains Policies
Author: Simon MEVEL
Co-Authors: Lionel G. FONTAGNE, Stephen Njuguna KARINGI, Yu ZHENG

Research question

The development of regional value chains (RVCs) and the engagement in global value chains (GVCs) is instrumental to Africa’s industrial transformation and economic development. These objectives also closely align with the major goals of the Agreement establishing the African Continental Free Trade Area (AfCFTA) which is currently under implementation. The AfCFTA aims to facilitate intra-continental trade of goods and services, where intra-African trade in intermediate goods and services could go a long way to promote and enhance the development of RVCs. The development of African RVCs is also expected to subsequently facilitate Africa’s participation in GVCs.
Against this background, the main objective of this study is to explore how the implementation of the AfCFTA Agreement may provide opportunities to strengthen value chains within Africa.
Specifically, we first examine Africa’s position in GVCs and the recent development of RVCs. Then, the potential linkages between the AfCFTA Agreement and regional/global value chains are established. In addition, a detailed description of Africa’s current tariffs, non-tariff measures, trade structures distinguishing goods and services for final and intermediate consumption is provided. Finally, based on the MIRAGE-VA computable general equilibrium (CGE) model, we simulate the implications of the implementation of the AfCFTA Agreement for RVCs in Africa to identify those sectors and sub-sectors that present the most potential for value-addition and the creation of RVCs.

Method & data used

An improved version of the MIRAGE-VA multi-country, multi-sector, dynamic CGE model is used for the analysis. Specifically, it includes a module on value addition differentiating goods and services for intermediate and final consumption. The model is calibrated for the initial year (2014) based on data from GTAP 10.1 Multi-Regional Input-output (MRIO) database, which has the

advantage to decompose trade in goods and services into final and intermediate uses. Long-term macroeconomic projections (GDP, labor participation rate and skills, current account, investment and saving rates, and energy efficiency) from updated results of a growth model known as the Macroeconometrics of the Global Economy (MaGE) (see Fouré et al, 2013 and Fontagné et al, 2022) are introduced in the model. Projections of fossil fuels prices (oil, gas and coal) are also considered. In the first step to construct the business-as-usual (BaU) scenario, the total factor productivity (TFP) is endogenous to reconcile the two models (i.e. MIRAGE-VA and MaGE). The MIRAGE- VA model therefore projects a reference trajectory of world economy which is consistent with the MaGE model. In the second step to construct the BaU scenario, key trade and climate policies are included, while keeping the TFP exogenous. Consequently, GDP, investment, and energy prices are endogenized.
We consider a realistic AfCFTA scenario assuming tariff liberalization in line with agreed AfCFTA modalities on trade in goods plus a 50% cut on actionable NTMs in both goods and services (within Africa). The NTMs in goods and services are cut linearly from 2021 to 2035, remaining constant thereafter and until 2045.

Novelty of the research & Findings

An analysis of Africa's current participation to backward and forward linkages with GVC is first performed and reveals that Africa's participation in GVC is limited. While the continent increasingly participates in GVC by exporting goods further transformed by other countries (i.e. forward participation), it participation to backward linkages which is assessed to be the most effective for GVC participation remains weak.
Crossing detailed data on trade and protection shows that both average tariffs and NTMs imposed by Africa on intra-African imports of industrial goods for intermediate consumption are higher than average tariffs and NTMs imposed by Africa on the same products from the rest of the world. This can be seen as a factor undermining the development of regional value chains. Therefore, the AfCFTA must and can play a key role (through the liberalization on tariffs and NTMs within the continent), especially in facilitating intra-African imports of industrial goods for value addition and regional value chains development in Africa.
The potential from the implementation of the AfCFTA Agreement to foster regional value chains in Africa is confirmed by the results from the empirical analysis based on CGE modeling, which explores how the AfCFTA may contribute to the development of Africa's RVCs and ultimately improve Africa's position on GVCs. Modelling results also confirm that the priority sectors (i.e. agro-processing, pharmaceuticals, automotive industry) identified under the AfCFTA processes have great potential for the development of Africa's RVCs, along with other sectors such as metals, wood and paper, and other manufacturing products.

How Enterprises are Multi-connected? An Empirical Case Study of Chinese Real Estate Enterprises Using A "Input-Output and Investment" Multi-layer Network

Topic: Industrial policies
Author: Anran MI
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How Enterprises are Multi-connected? An Empirical Case Study of Chinese Real Estate Enterprises Using A "Input-Output and Investment" Multi-layer Network

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Abstract:
This paper delves into the intricate multiplex network of relationships among enterprises. With the backdrop of the information technology revolution and economic globalization, enterprise has become more connected through multiple interactions encompassing transactions, guarantees, shareholding, and upstream-downstream connections. Enterprises thereby are more likely to influence each other. For instance, once the enterprise in these relationships has a crisis, then other enterprises with which it has various related relationships will also be affected. Therefore, it is urgent to study the multiple relationships among enterprises. Despite existing studies recognizing various types of single links among enterprises, such as transactional, shareholding, and interpersonal ties of manages, etc., there's a dearth of research into multiple links simultaneously in one framework that includes the interactions between these different types of connections.

Employing a multilayer network analysis approach, this paper cites some new multiple topological indicators that can be applied to multilayer networks and constructs multiplex networks to explore the structural evolution of relationships among real estate enterprises and their counterparts in other sectors, drawing on data from input-output tables, shareholding, and outward investment records from 2005 to 2020. In addition, this study also conducted a robust analysis, indicating that when a risk event occurs in a certain real estate enterprise, the enterprise with multiple links to the enterprise will receive a greater negative impact than the enterprise with a single link to the enterprise. Findings indicate a higher complexity in the input-output layer compared with the investment-related layer within the multiplex networks of real estate enterprises. Additionally, analysis of edge overlapping probability suggests a propensity among Chinese real estate enterprises for diversified operations, with most real estate enterprises are willing to invest in industries in their own input-output chain and most shareholding companies associated with real estate enterprises belonging to closely related industries in the input-output chain. Notably, post-2015, there’s a significantly positive correlation between the importance of nodes in the input-output layer and the investment-related layer, indicating a growing awareness among enterprises of the importance of input-output connections for mitigating risks and enhancing business resilience.

The marginal contribution of this paper is as follows. A new methodology measuring the multiple links of enterprises is prosed based on multilayer network analysis, which has promising applications in economic and finance fields, including behavioral finance, asset pricing, risk management, etc. It constructs the "input-output and investment" multi-layer network among enterprises innovatively, and explores the overall topology of the multi-layer network. The correlation between input-output correlation and capital link is explored. This paper underscores the significance of input-output interconnections in mitigating credit risk contagion among real estate enterprises, offering valuable insights into risk transmission pathways and exposure levels to aid both enterprises and regulatory authorities in safeguarding financial system stability.

Keywords: Multiple links; Input-output correlation; Capital link; Multilayer network; Network structure; Real estate enterprise

An Input-Output Assessment of the Brazilian Development Bank (BNDES) Financial Support on Employment

Topic: Employment Policies
Author: Thiago MIGUEZ
Co-Authors: Leonardo DE OLIVEIRA SANTOS

The Brazilian Development Bank (BNDES) is the main source of long-term funding for the Brazilian economy, and it is among the biggest development banks in the world. It provides financial support for almost every economic activity in Brazil (agriculture, manufacturing, services and infrastructure) so that companies can start or expand their productive capacity, innovate and export. It also reaches both small and medium sized enterprises (SMEs) and big companies. To accomplish such a diverse mission, BNDES has a wide range of financial instruments, including standard credit lines, project finance, securities (shares, debentures, funds, etc.), financial guarantee, and non-reimbursable resources (grants).

Input-output models have been used by BNDES staff mostly to estimate the number of employments associated with fixed investment projects, meaning the employments needed to produce capital goods, industrial warehouses and infrastructure. The IO model used to estimate BNDES' impacts on the supply chain of investment projects consists in a basic Leontief model build with the most recent IO matrix calculated by the Instituto Brasileiro de Geografia e Estatística (IBGE) for 2015:

$X = A.X + F$
$X = (I-A)^{-1}.F$, assuming $(I-A)^{-1} = L$
$X = L.F \quad => \quad \Delta X = L.\Delta F$

Where L is known as the impact matrix (or Leontief´s inverse matrix). Now, to calculate the employment impact, let e be a matrix of employment coefficients by sector (employment to output ratio) and E the vector of total employment by sector. Considering X=L.F, the impact on jobs can be achieved by:

$E = e.(L.f) \quad => \quad E = \underline{\quad}L\underline{\quad}.f \quad => \quad \Delta E = \underline{\quad}L\underline{\quad}.\Delta f$

In BNDES' case, the demand shock is mainly connected with Gross Fixed Capital Formation (GFCF). Expenditures in fixed investments were identified and separated from the total amount disbursed by BNDES each year. On the other hand, expenditures on acquisition of imported equipment, on securities not associated with projects and on working capital were not included. The selected annual disbursements were classified in 49 sectors and the values were deflated to 2015 prices using a sectoral price index.

However, the demand shock vector must be composed by the sectors responsible for providing goods and services purchased by the investment projects, not the sectors investing represented in BNDES's disbursements. To achieve this goal, the model uses an "Capital Flow Matrix (CFM)" which contains the average proportions of machines, construction and services needed for each sector investment projects.

The initial results were calculated for the 2014-2023 period. The results can be decomposed in: (i) direct employments, which occur in the sectors that provide goods and services directly to investment projects, for example construction, equipment manufacturing and engineering services; and (ii) indirect jobs, which correspond to the occupations in the supply chains of the previous sectors (i), for example, steel industry, electric material and cement. Almost 3 million jobs were associated with projects supported in 2014, a relevant outcome considering that in that year Brazil had about 40 million people working in formal occupations. The results fall over the next years, following the reduction in BNDES disbursements, but reach over 1 million jobs in 2022 and 2023. In average, about 59% of estimated jobs are direct jobs and 41% are indirect jobs.

The novelty of this paper is the way BNDES's data is tidied up to better fit IO analysis. The proposal for the final version of the paper is to advance in both input-output modelling and BNDES data using: (i) a series of annual IO tables (instead of using the IO matrix of 2015) estimated by Alves-Passoni and Freitas (2020); (ii) apply different methodologies for each BNDES financial instruments to expand the rate of disburments considered (ex: exports) and better calculate the demand shock; (iii) analyse other variables such as value added and taxes.

Finally, the expected general result is to qualify and quantify the impact of BNDES financial support in a sectoral perspective and also the development and consolidation of the IO framework as an effectiveness evaluation tool by BNDES and other development banks.

Endogenizing capital in the value-added analysis of trade

Topic:
Author: Sebastien MIROUDOT
Co-Authors: Bo MENG, Ming YE

This paper proposes a new methodology to account for capital goods and services in the analysis of global value chains (GVCs) and trade in value-added (TiVA). In conventional inter-country input-output (ICIO) models, capital is exogenously treated, which may underestimate the actual influence of capital on trade dynamics. Our approach endogenizes capital formation and incorporates both domestic and foreign capital contributions, resulting in the development of novel indicators that more accurately reflect capital's role in trade.

As GVCs are highly fragmented and complex, with production processes distributed across multiple nations, the need for accurate representation of all contributing factors, including domestic and foreign capital, has intensified. Traditional TiVA indicators capture domestic and foreign value-added from intermediate goods and services in exports, but cannot identify the role of capital in generating value added in exports. Capital goods like machinery, equipment, and infrastructure are instrumental in enabling production across GVCs. Capital services that are part of research and development processes and central in IT strategies of firms are also key to understand global production. The exclusion of capital's role in ICIO models applied to GVCs not only misrepresents the actual value creation in trade but also limits the understanding of a country's strategic participation in global production networks, as well as interdependencies across countries in terms of capital formation.

In the IO literature, two primary methods have been identified to endogenize capital: the augmentation technique and the flow matrix method. The augmentation technique involves adding a separate additional sector to the inter-industry flow matrix to incorporate capital. This approach creates an artificial sector with a homogeneous commodity "capital", which is used and

put into production according to the gross fixed capital formation (GFCF) vector and consumed based on the row vector of capital input. The flow matrix method decomposes capital by assets and sectors, creating a separate capital flow matrix. This matrix is then added to the conventional inter-industry matrix to construct the total flow matrix. By doing so, the role of capital is explicitly acknowledged, and the model captures the interdependence between capital and other sectors.

This paper's contribution lies in applying these capital-endogenized approaches to an ICIO framework and the decomposition of gross exports into value-added terms that reflect the foreign and domestic origin of value added. By constructing capital flow matrices that trace transactions between countries and industries, we assign value added associated with capital goods and services to the industries using them and we devise new indicators that measure domestic and foreign capital value added embodied in exports.

We calculate such indicators with capital matrices developed by the OECD that are consistent with the 2018 edition of OECD ICIO tables. Our empirical analysis highlights significant divergences in revealed comparative advantage (RCA) indices calculated with endogenized capital as compared to traditional RCAs based on gross exports or trade flows in value-added terms. The capital RCA approach reveals the export strength of major developed economies rooted in capital goods and services excellence, which traditional RCAs overlook. Comparison with standard TiVA accounting unveils systematically higher shares of value-added in intermediate versus final goods exports when capital is endogenized. This aligned with the role of capital goods in facilitating production across GVCs. Our capital-augmented ICIO framework offers a deeper insight into the interplay between capital and global production processes.

We believe this paper makes several key contributions to the existing literature:
- It addresses a significant gap in input-output and trade in value-added accounting regarding the treatment of capital as an exogenous component.
- It implements techniques from past input-output literature to endogenize capital within an inter-country setting and applies this to trade analysis.
- It provides a framework to calculate new value-added trade indicators capturing domestic and foreign capital's role.
- It highlights, through an empirical exercise, major shifts in the measurement of revealed comparative advantages and export competitiveness when capital is incorporated.
- It unveils systematically higher shares of value-added in intermediate versus final goods exports when capital is endogenized in comparison with standard TiVA accounting.

Estimating an extended informal sector Input-Output Table for India with an employment account based on workforce characteristics

Topic: Special Session: Extended SUTs and IOTs - experiences and techniques of national statistical institutes and international organizations
Author: Haruka MITOMA
Co-Authors: Norihiko YAMANO

In many developing countries, over two-thirds of total employment is engaged in the informal sector. The workforce in the informal sector can be characterized by increased vulnerability and lower wage rates compared to workers in the formal sector. Additionally, production activities involving informal employment are not fully regulated by the government. Therefore, aggregating formal and informal employment activities within each Input-Output Table (IOT) sector could

result in the loss of critical information on the economic structure in developing countries. In particular, this could introduce biases in employment impacts estimated from conventional IO analysis. To reduce such aggregation biases, this study introduces a "two-dimensional extended input-output analytical tool" with a distinction between the formal and the informal sector for the Indian economy. The first dimension of the extension is the transaction flows in input-output table, and the other extension is employment by workforce characteristics. We develop an informal sector extended IOT for India for multiple years as a case study using constraints from National Accounts statistics and the Periodic Labour Force Survey (workforce characteristics-extended microdata). Using this extended model, we analyse the relationship between final demand (by households and business) for different products and, the type of employment (formal or informal) used in their production.

Many economic studies have modeled national economies to explore the impact of the informal sector on value added, employment, and pollution. However, these studies do not fully pay attention to the evolution of industrial heterogeneity, which is critical information for developing policies. An extended input-output framework can provide statistical information on the significance of variations in the informal sector by industry and the interdependency between the formal and informal sectors. Some studies have estimated input-output tables considering the informal sector; however, the coverage of industries was not comprehensive, and they assumed the same intermediate input production structure for both the formal and informal sectors. To the best of our knowledge, this study is the first to attempt to develop informal sector extended input-output tables at a relatively detailed level of industry, with different production structures for the two sectors, and providing a time series of tables. This study is divided into the following three steps.

[1] Separating the production activities for all 45 industries of OECD's harmonised Input-Output Table for India into the formal and informal sectors using data on output and value-added from the informal sector (household sector) obtained from National Account statistics of India. We employed the proportionally assumption as well as estimates from previous studies (e.g., Rada, 2010 and Mitoma, 2023).

[2] Estimating the number of persons employed by industry belonging to formal and informal sectors and by characteristics of workers (e.g., gender, education, occupation, wage, whether they have social security or not) using microdata from the Periodic Labour Force Survey (PLFS), which recently became publicly available, covering the years from 2017 to 2023.

[3] Building a two-dimension extended input-output analytical tool by combining the input-output table estimated in step 1 and the employment matrix by industry and characteristics estimated in step 2.
Based on the informal sector extended time series input-output table, we further provide a decomposition analysis to break down the factors of economic growth into employment by characteristics in formal and informal sectors.

In general, the share of the informal sector decreases with national economic growth. However, in India, we found that the share of the informal sector's contribution to output only decreased slightly between 2011 and 2020. In some industries, the annual growth rate of informal employment was higher than formal employment. We also found that the impact of the informal sector varies among industries. In some labour-intensive industries such as agriculture, textiles and land transport, the informal sector made a major contribution to employment and gross value added, and the informal sector shares have risen. On the other hand, other labour-intensive sectors in services industries (e.g., wholesale and retail, business services and other personal

services) have slightly decreased their informal shares.
We believe that a set of time-series informal-sector extended input-output tables is a useful tool to provide new insights into how economic growth is influenced by the complex interplay between the formal and informal sectors in India.

A Bi-regional SAM's clusterization: disposable and primary factor income's dispersions indexes

Topic: Regional Analysis
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This paper aims to perform a clusterization technique to identify the dispersion effects between industries' productions and income distribution of Institutional Sectors, considering exogenous shock on disposable income. The methodology used is represented by the bi-regional Social Accounting Matrice (SAM) for the US and Mexico, from which we use a bi-regional extended multisector model (BEMM) (Ciaschini & Socci, 2007). Such methodology is used to identify the structure of direct, indirect, and induced effects that rise in both regions. The BEMM technically describes the income circular flows by each phase: the generation, the allocation, the distribution and the use of income. The clustering technique we develop is based on the correlation and cross-correlation of 'impact components'. This approach is called Macro Multipliers (MM) analysis (Ciaschini & Socci, 2007), which identifies all the latent structures of exogenous variables and their impact on the endogenous variables. Finding latent structures unable to perform backwards and forward dispersion analysis that aims to represent the structural matrix in bi-dimensional plots, capturing more than 70% of the total variance.
One of the multisectoral analysis and development economics topics is represented by the possibility of identifying 'key' industries (or groups of them) that are interdependent in an economic system. During the 1950s, Hirschman (1958) introduced the concept of linkages to explore and measure the inter-industrial relations and the multiplicative effects of investment. Rasmussen (1956) proposed the power and sensitive dispersion indexes, the most widely used technique applied to the Leontief inverse matrix. Chenery and Watanabe (1958) proposed a method to rank industries by their multiplier power using the sum of each column of the Leontief technical coefficients matrix. Those classical techniques represent the first attempts to create an index to rank output multipliers by industry to search the key sectors.
After 1960, new alternative techniques were proposed for ranking the industries, for example, the hypothetical extraction method (Strassert, 1968; Schultz, 1977); the total linkage (Cella, 1984) applied to a partitioned SAM; the eigenvector method (Dietzenbacher, 1992); the output-to-final demand elasticity index (Mattas & Shrestha, 1991). However, these techniques have a fundamental criticism: they assume an equi-distributed structure in the exogenous variable (Skolka, 1986), which is unrealistic. Indeed, the structure of the exogenous vector affects results in a way that implies avoiding this assumption (Ciaschini, 1993).
In the 1970s, there was an interest in identifying industrial complexes, groups or clusters in the input-output (IO) framework; for example, the pioneer contribution of Czamanski (1974) proposed an association's index to identify industrial clusters. Roepke et al. (1974) use factor analysis to identify industrial complexes with similar transaction patterns; those studies are done on the columns of the technical coefficient matrix; thus, both methods use only the so-called backward linkages. In the late 90s and early 2000s, Sakurai et al. (1997) identified the relevance of ICT industry clusters in ten countries using econometric regressions. Dietzenbacher and Los (2002) modified total and induced forward multipliers for the US economy, clustering the research and development investment effects. Hoen (2002) used diverse cluster-based techniques and pointed

out four problems: the clusters are sensitive with respect to the matrix analyzed; different data generally lead to different results; many methods generate a mega cluster without clear relationships; in many cases, the clusters consist only of two industries. Subsequently, Sonis et al. (2008) used the tools of topologic analysis and Q-analysis to identify clusters in an economic inter-industrial input-output table for the Chicago economy.
Finally, in the last decade, papers on industrial clustering have incorporated the use of indicators from the input-output framework; in some studies, these indicators are mixed with other accounting or statistical frameworks to identify the industrial clusters (Delgado, et al., 2016) or to identify the cluster of the financial industry in China (Khan, et al., 2024). Other contributions use clustering techniques to identify the most carbon-emitting industries in input-output tables (Kanemoto, et al., 2019) or to identify industrial clusters in Germany (Kosfeld & Titze, 2017) or the cluster associated with the construction industry in Russia (Kudryavtseva, et al., 2021). However, most of the papers above identify inter-industrial clusters, leaving out the link with the institutional sectors in the IO framework or even more in the SAM.
In conclusion, the methodology used in this paper is unable to analyze the interaction between institutional sectors and industries since the BEMM makes it possible to perfo

Implications of basic income policies for long-term climate goals

Topic: Special Session - Assessing Industrial, Trade and Green Transition Policies Through SFC-IO Models
Author: Guilherme Spinato MORLIN
Co-Authors: Iñaki ARTO, Kurt KRATENA, Manuel TOMáS, Maria Victoria ROMÁN, Simone DALESSANDRO

The transition to a sustainable and low-carbon economy presents social and economic challenges that require new policies to ensure minimum standards of living for everyone and to reduce inequalities. In this context, a universal basic income policy can support individuals and communities during the green transition. However, implementing this policy can create a fiscal burden, leading to higher deficits and increased debt if not compensated by greater tax revenues. In this regard, progressive tax reforms aimed at raising revenues from the better-off individuals of the society, such as a wealth tax, might provide the funding required for the implementation of the universal basic income while further decreasing inequality. Nevertheless, a universal basic income can have negative feedback effects on climate goals by promoting consumption and economic growth. To mitigate this trade-off between reducing inequality and greenhouse gas (GHG) emissions, a carbon tax that helps to internalize the external costs of carbon emissions might be introduced as part of the tax reform. To investigate the impact of these policies, we used the Within Limit Integrated Assessment Model WILIAM, a macroeconomic multi-regional input-output model that integrates physical energy, material flows and constraints, as well as climate change damages. Our simulations reveal that these policies substantially reduce inequality but can only partially prevent the negative feedback effects on environmental variables. We discuss the factors behind the potential trade-offs between environmental and equity goals and provide recommendations for policy design and future research.

Responsibility of Japanese economy for the impacts on aquatic ecosystems arising from induced water consumption in global supply chains

Topic: Sustainable Production and Consumption Policies
Author: Masaharu MOTOSHITA
Co-Authors: Kamrul ISLAM, Keisuke NANSAI, Stephan PFISTER, Francesca VERONES

Biodiversity becomes of high interest in the context of global sustainability. Freshwater consumption could threaten the freshwater species by depriving natural water resources inevitable as their habitats. Globalized economy results in remotely induced water consumption in supply chains, which makes it difficult to identify the causes of the impacts of water consumption on biodiversity. In the previous study, we have demonstrated the responsibility of our final demand for water consumption hidden in the global supply chains and its sustainability in terms of local carrying capacity of water resources based on the Global Linked Input-Output (GLIO) model. Here we advance the analysis for the assessment of biodiversity impacts by water consumption in global supply chains. The induced water consumption in the global supply chains is calculated by water consumption inventory for 231 countries at sectoral level (around 5,000 sectors) with the GLIO model. Then, the overconsumption beyond the regional carrying capacities of water resources induced by Japanese final demand was estimated by adopting the regional carrying capacity indicators developed in the previous study. The impacts of water overconsumption on the riverine fish species are assessed by adopting the characterization factors at water basin scale.
Japanese final demand results in the potential loss of 0.18 out of 11,450 riverine fish species annually, which is relatively smaller in comparison with the proportion of Japan-induced water consumption in the global supply chains to the total water consumption in the world. On the other hand, Japan is relatively more responsible for the biodiversity impacts in some specific countries that are not identified at the global level. This indicates that each country could have their own countries that they should take responsibility for. In terms of influential commodities that induce the large potential of biodiversity loss in the global supply chains, food-related goods consumed by Japanese accounts more than half of the total loss of biodiversity, however, fossil fuel-based products, metal- and mineral-based products, and electricity and utilities surprisingly accounts for 1/4 of the total loss associated with Japanese final demand regardless of their relatively small volumes of induced water consumption.

Estimating Life Cycle Carbon Emissions from Intermediate Goods and Its Driving Force

Topic: Energy policies
Author: Fumiya NAGASHIMA
Co-Authors: Shohei TOKITO, Tesshu HANAKA

The development of the world economy has expanded through trade. As global supply chains expand and become more complex, the share of CO2 emissions induced by final consumer goods, especially in developed countries, that are emitted abroad is increasing. In the emission responsibility for international trade on climate change control, consumption-based accounting has been proposed as complementary to direct emissions from industrial production (production-based accounting), an approach to the problem of emission transfer between emitting and consuming countries. However, the progress of international specialization and the consequent expansion of trade in intermediate goods led to the difficulty in evaluating the

emission responsibility of intermediate goods producers in international trade using existing emission accounts. With this background, this study applies the hypothetical extraction method (HEM) after Szyrmer's total flow concept to trace the embodied emissions of intermediate goods production in international trade. We also develop the new structural decomposition framework corresponding to the above HEM indicators and identify the drivers of change in embodied emissions considering downstream structure and upstream.

Based on the multi-region input-output (MRIO) database from 2000 to 2018, for the case study of Japan, we found that carbon emissions from exports of intermediate goods increased, with a particularly large increase in emissions outside of the country. Although upstream supply chains in industries such as computer and motor vehicle manufacturing have been relocated overseas, growth in intermediate demand from abroad contributed significantly to domestic value-added creation. In addition, the growth in emissions associated with exports of intermediate goods such as chemicals and metal products was larger than the growth in domestic value-added. The results of structural decomposition indicate that chemical products have a large potential for emission reductions through the improvement of domestic emission factors and basic metal products contributed to emission reductions while domestic value-added growth slowed down due to the offshore transfer of supply chains. There is a trade-off between domestic value-added growth through exports and emission reductions in the basic metal industries.

Impact of Promoting Wood Utilization in Buildings on CO2 Emissions in Japan

Topic: Input Output Analysis and policies
Author: Ai NAGATA
Co-Authors: Shigemi KAGAWA, Sora MATSUSHIMA

Following the adoption of the Paris Agreement in 2015, the Japanese government declared its goal of becoming carbon neutral by 2050. To achieve carbon neutrality, it is essential to enhance CO2 absorption while simultaneously reducing CO2 emissions. Especially in the building sector, the use of wood, a highly carbon-storing material, can increase CO2 absorption. Therefore, the incorporation of wood in buildings is necessary as a sink measure to achieve carbon neutrality. In response to this trend, wooden buildings are being constructed taller and taller worldwide (Uniben et al., 2019), and several previous studies have demonstrated the CO2 emission reduction benefits of promoting the use of wood in buildings (Borjesson & Gustavsson, 2000; Gustavsson et al., 2006; Gustavsson et al., 2010).

However, the impact of increased societal demand for high-rise buildings on the country's economy and environment is not clear. In Japan, the government enacted the Law on the Promotion of Utilization of Wood in Buildings for Realizing a Carbon-free Society in 2021 to promote the use of wood in buildings and achieve a carbon-neutral society. However, the Japanese government has yet to introduce a policy focusing on the scale of buildings (i.e., the number of floors in this study) to promote the use of wood. Therefore, this study addresses a crucial research question: How much can CO2 emissions be reduced by promoting the use of wood in residential construction in Japan, especially by increasing the number of floors in wooden building construction?

The novelties of this study are as follows. First, this study represents the first attempt to estimate the supply chain CO2 emissions of detailed construction methods based on the number of floors

in houses (e.g., supply chain CO2 emissions of two-story wooden house). To this end, we adopted an Environmentally-Extended Input-Output (EEIO) analysis and calculated direct and indirect CO2 emissions in the construction supply chain of houses in Japan by construction method and by the number of floors, based on the Japanese Input-Output Tables in 2015 and the Embodied Energy and Emission Intensity Data (3EID) for Japan Using Input-Output Tables provided by the National Institute for Environmental Studies of Japan, and the statistical survey of building starts in 2015 by the Ministry of Land, Infrastructure, Transport and Tourism.

Second, this study estimated the change in CO2 emissions under scenarios of building technology improvement, specifically focusing on the construction of taller wooden buildings. This study analyzed how the direct and indirect CO2 emissions associated with demand for medium- and high-rise residential construction change with wood construction by varying the lumber, concrete, and steel sectors of the input data for houses by estimated construction method and number of floors.

As a result, direct and indirect CO2 emissions from the construction demand of houses in Japan amounted to 31,911 kt-CO2. We also found that for houses with 1 to 3 floors, the highest CO2 emissions come from wooden houses, however the CO2 emissions per wooden house were relatively small, largely due to the large number of wooden houses. On the other hand, for houses with 4 or more floors, the highest CO2 emissions were from reinforced concrete houses, influenced not only by the large number of houses but also by the significant CO2 emissions per house.

We then calculated the carbon storage for wood used in houses by construction method and by the number of floors, based on Forestry Agency guidelines. We found that for any number of floors, the carbon storage in wooden houses was about four times greater than that in reinforced concrete houses. Additionally, we found that the direct and indirect CO2 emissions per square meter of wooden houses decrease as the number of floors increases. Furthermore, we observe that direct and indirect CO2 emissions in the construction phase of houses are significantly reduced in a scenario where the construction of high-rise residential wooden buildings is promoted.

Finally, based on these results, we propose a demand-side policy (i.e., subsidy policy and/or ecolabeling policy) to promote the construction of high-rise wooden houses.

Multipliers and Linkages Analysis for Brazil: The Role of Cerrado Agribusiness

Topic:
Author: Marcos Spínola NAZARETH
Co-Authors: Geraldo MARTHA, Rayan WOLF, Cicero ZANETTI DE LIMA

Only over the past few decades Brazil was able to transform its agriculture into a dynamic and productive sector, following a strategy anchored on a science-based approach. Agricultural industry and services, benefiting of agricultural raw materials supplied at competitive prices, availability of basic infrastructure, and favorable export food prices, feed, and fiber was able to rapidly develop. Prospects are positive for agricultural value chains, with projections of agricultural output and exports expansion. Regionally, the Brazilian Cerrado has established itself as one of the main grain and livestock breadbaskets in Brazil and internationally in a few decades. Thus, agricultural industry and services also became key sectors of the Cerrado

economy. The importance of agricultural value chain to Brazil's economy, and to the Cerrado's States in particular, emphasizes the need to structural economic analyze to guide a better decision-making process. Then, the objective of this study is to analyze the multipliers and linkages of the Brazilian economy in a regionalized way, with emphasis on the role of agribusiness in the Cerrado. To this end, were calculated the multipliers and linkages of the Brazilian interregional IO model built for 2021, the most recent year of the regional accounts. The model is disaggregated into 11 regions, including the states of the main agricultural belt, and 37 sectors representative of the Brazilian economy. Such update and expand analytical framework is not only important from an economic perspective. It is also relevant from an environmental perspective given the agricultural sector role in land use dynamics and conservation of natural resources. Strategies have been adopted to promote sustainability, such as investments in technological development aimed at improving agribusiness activities in a more efficient and sustainable way. Then, identifying the economic connectedness, possible transmission channels of these initiatives and their spillovers in the country becomes even more important.

The Triple Bottom Line Analysis of the Decline in Foreign Tourist Demand in Japan due to the COVID-19 Pandemic: A Counterfactual Structural Path Analysis

Topic: Regional Analysis
Author: Yusuke OGA
Co-Authors: Shigemi KAGAWA

The COVID-19 pandemic brought significant risks to the tourism industry, exemplified by Japan's experience. Despite adopting policies to boost tourism, including visa easing and expanded shipping routes, Japan faced an 87% decline in foreign visitors in 2020 due to lockdown measures. This led to substantial economic losses. While the pandemic has somewhat subsided by 2024, the tourism industry remains vulnerable to potential pandemics and other disasters, such as earthquakes and terrorism, given its reliance on human mobility. Recognizing the importance of the tourism sector, the Japanese government must formulate disaster preparedness policies, considering economic, social, and environmental aspects. This study aims to quantitatively assess the detailed impacts of the COVID-19 pandemic on the tourism industry using Input-Output analysis, SDA analysis, and SPA analysis.

To evaluate the economic, social, and environmental repercussions of the COVID-19 pandemic in 2020, two scenarios were defined: one with and one without the pandemic. The 'with-COVID' scenario reflects the actual conditions, incorporating the 2020 foreign visitor numbers to Japan and per capita commodity consumption. Conversely, the 'non-COVID' scenario serves as a counterfactual, estimating foreign visitor numbers and commodity consumption as if the pandemic did not occur. In each scenario, a new consumption-endogenous input-output analysis framework was developed, encompassing a counterfactual model for both pandemic and non-pandemic situations. This allowed for an examination of the direct, indirect, and income-induced economic, social, and environmental effects resulting from the decline in travel consumption by foreign visitors in 2020. Furthermore, a counterfactual Structural Decomposition Analysis (SDA) framework was constructed, considering economic structures with and without the pandemic. This assisted in identifying primary factors contributing to changes in economic, social, and environmental effects. Ultimately, a Structural Path Analysis (SPA) framework was applied to identify key supply chains associated with economic, social, and environmental impacts, respectively."

Our findings revealed that the pandemic caused a decrease of 33 million foreign tourists in Japan, resulting in economic losses of 5.88 trillion JPY (approximately 39.6 billion U.S. dollars as of October 15, 2023), social losses affecting 956 thousand people, and environmental benefits equivalent to 12.9 Mt-CO2 emissions. These three aspects (economic, social, and environmental) were strongly affected by hotels, eating and drinking services, and rail passenger transport, which account for a large part of tourist consumption tendency. In particular, hotels and eating and drinking services induce a huge electricity demand and indirectly contribute to the reduction of CO2 emissions from the electric-supply industry.
Decomposition results further showed that the sharp decline in final demand by foreign visitors to Japan due to the COVID-19 pandemic led to a 100.4% reduction in value added. Conversely, a shift in the production structure under the pandemic contributed to a 2.9% increase in CO2 emissions.

In conclusion, we propose two crucial factors for the development of the most sustainable and efficient countermeasures: (1) the recovery of economic and social losses and (2) the reduction of CO2 emissions associated with inbound final demand. To address economic and social losses, the government should provide sector-specific stipends based on the magnitude of the losses, and our data can serve as evaluation criteria for distribution. Our analysis encompasses not only the easily recognizable direct effects but also the more challenging-to-estimate and often overlooked indirect and income effects.
To sustain the reduction of CO2 emissions linked to inbound final demand, we recommend the government integrate a mechanism into counter-COVID-19 measures. This mechanism should determine incentives for industries to enhance business conditions while simultaneously reducing environmental impact.
As of February 2024, the risk of another pandemic due to the emergence of a mutant strain cannot be entirely dismissed. Furthermore, the vulnerability of inbound tourism-related industries revealed in this study is susceptible to risks beyond COVID-19. This study offers crucial insights for stakeholders to consider in measures implemented by the Japanese government in the event of a future pandemic recurrence or unforeseen disasters.

Unveiling the Panama Canal's Economic Influence: An Input-Output measuring

Topic: Input-Output Theory and Methodology
Author: Maria Laura OJEDA
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This paper offers a comprehensive analysis of the economic impact of the Panama Canal on the Panamanian economy in 2022. Utilizing an Input-Output model calibrated with a detailed Social Accounting Matrix and Employment Satellite Account, the study examines the direct contributions of the Canal, exploring its interindustry connections, labor dynamics, and effects on government finances. The Hypothetical Extraction exercise within the Input-Output framework quantifies the broader economic ramifications. Results highlight the Canal's pivotal role, extending beyond direct contributions, and emphasize its significance in shaping the national economy. The Canal's total contribution to GDP is estimated at 7.7%, exceeding 23% in government revenues (mainly dividends). Regarding exports, 15.9% can be attributed to the Canal. Additionally, the Canal significantly contributes to job creation, accounting for 2.9% of total employment. This study provides valuable insights for policymakers and stakeholders, aiding informed decision-making and sustainable development strategies in Panama's ongoing economic journey.

Economic Structural Changes and Impact Analysis of Disasters

Topic: Disaster analysis
Author: Yasuhide OKUYAMA

The impact analysis of a disaster often employs an input-output (IO) table or a social accounting matrix (SAM) of the pre-disaster period to estimate the higher-order (ripple) effect. While computable general equilibrium (CGE) models for disaster impact analysis also use a pre-disaster IO table or SAM for interindustry relationships, they adjust the interindustry and spatial relationships through the optimization process, resulting in input and/or spatial substitution changes. The previous studies found that changes in regional economic structure caused by damages from a disaster (the 1995 Kobe Earthquake) appear substantial (Okuyama, 2014, 2015, and 2019). The structural change by a disaster is not accounted for in the pre-disaster IO table or SAM, and is potentially not effectively reflected by the optimized structure in the CGE models, due to the built-in mechanisms in the economy, such as resilience, which adjust and cope with such a dire situation (Dacy and Kunreuther, 1963). This study uses the pre-disaster and post-disaster IO tables, compared with the estimated no-disaster IO table in the same year as the post-disaster table using the shift-share decomposition technique, to evaluate the differences of the economic structure, particularly interindustry relationships, among these three tables. In addition, their structural differences are examined using various IO techniques, such as linkage analysis, key sector analysis, analysis of multipliers, singular value decomposition, and so on. The results reveal the diverse effects of the disaster on the regional economy, especially among the manufacturing sectors. In this regard, the use of the pre-disaster table for the impact analysis of the event derives a misleading estimation.

COASTAL ECONOMY OF RIO GRANDE DO SUL/BRAZIL: MEASUREMENT AND SECTORAL PROFILE

Topic: Sustainable Production and Consumption Policies
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Co-Authors: Daiane HENKE, Rodrigo da Rocha GONçALVES

The Ocean Decade, proposed by the Intergovernmental Oceanographic Commission (IOC) of UNESCO (United Nations Educational, Scientific and Cultural Organization), was declared by the UN in 2017 as the Decade of Ocean Science for Sustainable Development, spanning from 2021 to 2030. Its aim is to raise global awareness about the oceans' significance and foster international cooperation for ocean preservation. According to UNESCO (2020), oceans, covering 71% of the planet, are potent climate regulators, yet less than 5% of it is known. They sustain 3 billion people, provide 30 million direct jobs, and generate an annual wealth of US$ 3 trillion, positioning the oceanic region as the 5th largest economy globally. However, with the expansion of marine industries, conflicts of interest arise, underscoring the necessity of a more integrative approach for sustainable growth and maritime economy development.
Brazil possesses vast maritime potential, encompassing the Blue Amazon, a 4.5 million km² area. The Blue Amazon facilitates 95% of Brazil's foreign trade and holds approximately 90% of its oil and gas reserves (Brazilian Navy, 2021). Alongside established activities like fishing, oil exploration, and tourism, emerging sectors such as seabed mining, renewable energies, and biotechnology offer further opportunities for development.
Hence, this paper seeks to estimate an Input-Output Matrix with a CO2 emissions module to quantify the sectoral profile of Rio Grande do Sul's coastal region. Its objective is to formulate public policies aimed at reducing the region's climate vulnerability. The coastal zone of Rio

Grande do Sul (ZCG) comprises over 30 municipalities, including Lagoa dos Patos lagoon, with an area of approximately 265 kilometers. With a population of about 1,488,819 people (IBGE, 2020), accounting for 13.03% of Rio Grande do Sul's total population, the ZCG boasts numerous beaches and Conservation Units, indicating environmental richness (Taim Ecological Reserve, Patos Lagoon and Mirim Lagoon). However, it is also the Brazilian state most affected by climate change, leading to economic and life losses due to natural disasters.
This work's significant contribution lies in quantifying the coastal economy's specific geographical and environmental segment, presenting concepts of coastal and marine economy, its GDP participation, and dominant activities, while striving for sustainable balance. These topics remain underexplored in international and national literature, hence the paper aims to address this gap. The results indicate that the region contributes 9.1% to Rio Grande do Sul's GDP, with its economic profile centered around agriculture, livestock, forestry production, fishing, aquaculture, trade, and vehicle repair. Achieving a sustainable economy necessitates growth and development within a sustainability and innovation framework. This entails restoring damaged ecosystems, ensuring integrated management, and fostering expertise across various segments, transitioning from a purely maritime economy to a blue maritime economy efficiently.
A major challenge is defining a regional maritime economy concept and establishing legislation to delineate maritime-related activities. Additionally, developing a strategic plan for economic and social development in Rio Grande do Sul, prioritizing collaborative governance, is imperative.

Analysis of Central American trade integration from the perspective of intraregional value added

Topic: Trade and Global Value Chains Policies
Author: Roberto Carlos OROZCO-MORALES
Co-Authors: Ramon PADILLA PEREZ

This article aims to study trade integration in Central America in terms of value added based on the first subregional input-output table, a tool developed by the Economic Commission for Latin America and the Caribbean (ECLAC) in close cooperation with the central banks and statistical institutes of the region. In particular, this article will examine whether the Central American integration strategy, which has been successful with regard to gross exports, has also been effective in incorporating intermediate inputs from within the subregion itself.

Indicators for value added from trade within Central America, based on the first subregional input-output table, enable an innovative analysis that is unprecedented in economic literature. To conduct a comprehensive assessment of trade integration, the methodology used for this study considers both the flow of exports between economies and the imported inputs for the production of exports.

This is achieved by using the indicators proposed by Stehrer, Forter and Vries, which generalize the calculation of vertical specialization by simultaneously estimating the value added created by exports and imports. The method consists of determining the flows of exports and imports from a given country, called the anchor country, and then estimating the value added created by those flows using the Leontief model.

From a regional perspective, the size and composition of value added created by trade show to what degree economies interact in regional productive processes and their dependency on them, making it possible to measure trade integration in terms of value added.

Calculations of the trade-induced value added (exports and imports) show that the share of subregional foreign value added embodied in subregional exports is low, as is the share of multilateral and reimported value added created by imports. The highest share is recorded in Honduras, where the sum of these values is 6%, while the lowest share is recorded in Panama, at just 1.8% of all subregional trade. In contrast, intermediate imports from countries outside the subregion account for an average of 30% of gross exports within the subregion.

In other words, imports from countries of the subregion create very little indirect value added, given the low share of intermediate inputs originating in the subregion, as represented by the low values for the indicators for multilateral and reimported value added. The statistics show that although the gross value of subregional trade is high, Central America is largely dependent on inputs from outside the subregion.

This analysis also shows that there are various profiles as regards trade within the subregion and value creation through exports and imports. In El Salvador, Guatemala, Honduras and Nicaragua, the share of domestic value added embodied in exports to Central America is lower than the share of bilateral value added created by imports; in Costa Rica and Panama, these proportions are reversed.

A more in-depth analysis could look into specific sectors and value chains, such as those of textiles, garments and the agrifood sector, which are extremely important in Central America. Another avenue for future research would be to conduct a dynamic analysis by updating the subregional input-output table, making it possible to study changes in the indicators over time.

The consequences of global reshoring trends in the EU carbon emissions

Topic: Special session: Environmental impact of global value chains reconfiguration
Author: Mateo ORTIZ
Co-Authors: Luis A. LOPEZ, Ángela GARCíA-ALAMINOS, Maria Angeles CADARSO

Recent events, such as the Covid-19 pandemic, trade wars and changes in policy orientation have accelerated some previous trends in international trade and global value chains (GVC). The exposed vulnerability of GVC is driving firms into a trend of returning part of the activities that were previously delocalised to faraway countries back to the regions where some of those production stages previously took place. These processes, referred by the literature as re- and backshoring, imply shortening supply chains to make them more regional and domestic rather than global, aiming at increasing sustainability and resilience of GVC. Current relocation patterns imply bringing back production not only to the home economy, but also to close economies in a geographical, political or economic sense, which is referred as nearshoring or friendshoring by the literature

Changes in policy orientation in western countries are contributing to this evolution. For instance, the EU's Open Strategic Autonomy and the European Chips Act, whereby the EU seeks to increase its autonomy in the supply of strategic goods through reshoring and supplier diversification programs and alliances. Increasing the resilience of the GVCs of companies and countries is linked to another global challenge: the energy and digital transition toward low-carbon economies.

In this article, we use an environmentally extended multi-regional input-output model (EEMRIO)

to assess how the reshoring trends linked to the EU's Open Strategic Autonomy affect the carbon footprint of the EU. The core dataset of our model is the OECD inter-country input-output database which is combined with detailed international trade data from Eurostat (4-digit code in HS nomenclature) to identify the trade partners that currently concentrate the supply of strategic products to the EU. The integration of international trade data at product-detail level allows us to identify and isolate the proportion susceptible to reshoring strategies within the broad aggregate sectors of the input-output framework. Thus, we apply an innovative "partial" source shifting technique to evaluate the net effect that the relocation and diversification of suppliers will have on global emissions.

We will evaluate whether backshoring strategies are more (or less) effective than nearshoring strategies in reducing the EU's total carbon footprint and whether these policies will mainly affect CO2-intensive industries or relatively low-carbon industries. Besides, we quantify the trade-offs and synergies between the resilience goal and the carbon mitigation one caused by new trade trends resulting from industrial policy reorientation.

Our preliminar results show that both backshoring and nearshoring result in net savings of the EU’s carbon footprint for the five selected strategic products. Reshoring results in a minor increase in emissions in the EU countries and, therefore, has a minimal effect on the emission reduction targets committed by the EU. However, as it does significantly reduce imported emissions, reshoring/nearshoring reduces the climate change risk of sectors that import the relocated products by reducing their carbon footprint, so they contribute to the goal of “de-risk” expressed by European Commission president Ursula von der Leyen. These results imply that pursuing the goals of the EU’s Open Strategic Autonomy according to the selection of suppliers can reveal synergies with the environmental goals and the fight against climate change. Reshoring and nearshoring would result in a diversification of suppliers for the analyzed products, as for all except for Iron and Steel, the primary supplier represents 40% or more of the total imports.

This study highlights the need to assess the environmental impacts of relocation and resilience-seeking decisions by companies and governments. In particular, the development of an EEMRIO model combined with detailed international trade data is useful to map the complexity of global carbon chains and to disentangle the sectors supplying emissions from international trade. The relevance of the study for scholars and policy professionals is that the results obtained are useful for analyzing the existing relationships between building EU resilience, foreign trade, and climate change policies, with the aim of pursuing their coordination and the reduction of conflicts of objectives between these policies in the design of future trade-restructure actions.

Refining product resolution of multi-regional input-output tables using parameterised production functions

Topic: Sustainable Production and Consumption Policies
Author: Albert Kwame OSEI-OWUSU
Co-Authors: Stefano MERCIAI, Mathieu Thierry DELPIERRE, Maddalen AYALA, Philip Holger Lindholt COENEN, Jannick SCHMIDT

Environmentally-extended multi-regional input-output (MRIO) databases offer valuable insights for evaluating the sustainability of global supply chains and providing policy-relevant information to achieve sustainable production and consumption of goods and services (SDG 12). These databases provide trade-linked impacts of global consumption, complementing national

input-output tables. However, their highly aggregated product/industry dimension is a limitation that restricts their application in assessing the socio-economic and environmental impacts of specific products or industries at national or global levels. While some studies suggest using proxy information to disaggregate industries/products can improve the accuracy of input-output multipliers, others introduce hybrid input-output life cycle assessment (IO LCA) databases that combine the high product resolution of LCA databases and the completeness of IO tables to address the issue of highly aggregated IO tables. However, these approaches have limitations related to data uncertainty and modelling assumptions required to estimate inter-industry use of production and input use by the disaggregated product/industry.

The present study introduces a novel procedure and algorithm that uses parameterised production functions (PPFs) to disaggregate MRIO tables. This method involves characterising the production processes of products, considering all inputs and outputs across their entire life cycle. By adjusting the parameters, we can analyse various scenarios, such as the influence of changes in input requirements or production conditions on production volumes and emissions.
Our method for disaggregating IO databases differs from previous approaches by providing country-specific production recipes that account for nuanced differences in production technologies, feedstock requirements, and other factors. Our approach considers primary product substitution and by-products for treatment, which are not inherent in traditional IO tables based on industry technology assumptions. To demonstrate our method, we introduce a PPF for methanol and show its practical application in providing country/region-specific input recipe data for the 'chemicals not elsewhere classified' product/industry within the EXIOBASE database.

Focusing on product-level disaggregation, The study utilises the hybrid EXIOBASE global MRIO database version 3.3.18 4, which comprises production recipes for 164 products across 44 countries and five regions. The research is a part of the Getting the Data Right project, which aims to create a unique open-source climate footprint calculator based on an upgraded hybrid EXIOBASE that includes global supply chain data and environmental extensions for over 1000 products and all countries, including sub-national regions. By examining various benchmark indicators, such as carbon footprint and direct input coefficients, we identify and shortlist more than 30 products for disaggregation. Key products include non-metallic minerals like cement, chemicals like methanol and ethylene, metals like aluminium and steel, and plastics such as polyethylene and polyvinyl chloride.

Our PPF algorithm relies on information from the IPCC Guidelines for National Greenhouse Gas Inventories, industry reports, scientific literature, and life cycle inventory or LCA databases. We use pertinent mathematical equations and models derived from these sources to encode the input-output relationships to produce products in Python programming language. The processes in this study are based on physical units, and carbon and mass balances are determined following the guidelines established by the Intergovernmental Panel on Climate Change (IPCC) or conventional methodologies. The PPF systematically evaluates the carbon content of inputs and outputs and the wet weights of product flows. Additionally, we compute carbon emissions associated with production using Life Cycle Assessment (LCA) and IPCC-recommended equations.

Disaggregating input-output tables is crucial for revealing nuanced product and industry environmental hotspots, capturing complex inter-industry and country interdependencies, simulating scenarios for sustainable transitions, and informing policies. However, securing sufficient granular data for disaggregation poses confidentiality, consistency, and modelling challenges. Therefore, it is essential to choose an appropriate level of disaggregation that balances informative detail with practical feasibility. Additionally, product-level and geographic disaggregation of IO tables should be considered, as some major producing/consuming countries

may be hidden in the highly aggregated Rest of the World (RoW) of EXIOBASE.

Chinese provincial CO2 emission flows in global production

Topic:
Author: Chen PAN
Co-Authors: Jianwu HE, Shantong LI, Yibing ZHANG

As the key implementer in achieving China's climate target, Chinese provinces, with their diverse resource endowments, locational conditions, and development foundations, have aroused wide attention. Being fragmented by the increasingly complex global production, the CO2 emissions embedded in trade led to concerns about potential carbon leakage and the reallocation of responsibility. To provide an accounting base for further analytical studies, this paper decomposes the CO2 emissions of Chinese provinces by flowing route based on the most up-to-date Inter-Country Input-Output model of the year 2017 with Chinese provinces embedded, following the accounting framework for global value chains.

The CO2 emissions of a province are decomposed into five terms of three categories: (1) the non-traded CO2 emissions, referring to the CO2 emissions embedded in the products produced and consumed locally; (2) the CO2 emissions via traditional trade, referring to the CO2 emissions embedded in products produced locally but consumed in other regions; (3) the CO2 emissions via cross-border production trade, referring to the CO2 emissions embedded in products produced by multiple regions, i.e., the cross-border production network. The cross-border production trade includes simple cross-border production trade that only crosses the border once, and the complex cross-border production trade that crosses the border multiple times. The latter can be further decomposed into two terms by whether the products finally flow back to the original region or not.

Results show that CO2 emissions embedded in cross-border production, especially those crossing borders more than once, dominated Chinese provincial CO2 emissions in 2017. At the sector level, high CO2-intensive sectors originally emitted the CO2, while some less CO2-intensive manufacturing and service sectors play a major role in the mid- and down-stream of the cross-border production, and differences exist between the production processes crossing borders once and multiple times. At the regional level, compared to the destinations when CO2 first crosses borders, more international regions are involved in leading the multi-time cross-border production network. Besides, the United States is a crucial final destination for Chinese provincial CO2 emissions via multi-time cross-border production and traditional trade. Based on these findings, the potential pathways for CO2 reduction in Chinese provinces are discussed.

Structural Decomposition Analysis of Changes in Effective Protection for Brazilian Tradable Goods (2005-2023)

Topic: Trade and Global Value Chains Policies
Author: Patieene Alves PASSONI
Co-Authors: Marta Reis CASTILHO, Marcelo Resende TONON, Adriano DUARTE

The primary objective of this study is to comprehensively analyze the evolution of effective protection for Brazilian tradable goods over the years 2005, 2008, 2014, 2021, and 2023. This

analysis involves a structural decomposition of nominal import tariffs, domestic inputs, and imported inputs.

Effective protection, as conceptualized by Corden (1971), is a measure of the protection afforded to final goods, accounting for the applied tariffs on inputs and weighted by their significance in the final good's value (technical coefficients of the input-output model). This study employs a partial equilibrium analysis, utilizing information on the productive structure and considering changes in domestic value added in comparison to a counterfactual scenario of a free market.

The Effective Protection of an Activity (EPA) is defined as the disparity between observed added value and the hypothetical added value in a tariff-free scenario for both the activity and its inputs. This difference is presented as the percentage variation in protected domestic value added, influenced by tariffs on the final good and imported inputs.

The proposed decomposition categorizes effective protection into three components: the impact of changes in nominal tariffs on imported goods, domestic inputs, and imported inputs. Given that tariffs affect both the direct import of the product and its inputs in national production chains, a specialized treatment is necessary. The Bennet method, suggested by de Boer and Rodrigues (2020), is employed for this purpose.

Calculation of EPA requires two essential pieces of information: the nominal tariff protection structure provided by the Secretariat of Foreign Trade (SECEX) of the Brazilian Ministry of Development, Industry, and Commerce, and the production structure obtained from national Input-Output Tables (IOT). As official MIPs are released by the Brazilian Institute of Geography and Statistics (IBGE) at five-year intervals ending in zero and five, this study uses IOT estimates by Alves-Passoni and Freitas (2020) for non-corresponding years.

The novelty of this study lies in its methodology, which unravels the changes in effective protection. Unlike previous studies that calculate effective protection without identifying the key elements explaining the change, this research aims to fill this gap.

Preliminary findings reveal a decline in effective protective tariffs over time, primarily attributable to nominal tariffs. However, changes in domestic and imported technical coefficients exhibit opposite trends, generally contributing positively to increased effective protection. Notably, despite imported inputs constituting 30% of total inputs in the Brazilian economy, they play an equal or greater role in decreasing effective protection compared to domestic inputs. This may be attributed to both an increase in the relative price of imported inputs in the Brazilian production process and an augmented dependence on these inputs.

The environmental unintended consequences of a potential EU-MERCOSUR free trade agreement. An analysis for the agri-food industries in Spain.

Topic: Special session: Environmental impact of global value chains reconfiguration
Author: Yolanda PENA-BOQUETE
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Latin America is seen by the European Union (EU) member states as a key region to trade with. Spain is particularly involved in the region due to its former metropolitan role with a majority of its countries. Nowadays, the EU and MERCOSUR appear to be close to the signature of a free

trade agreement (FTA). As a consequence, the direct trade flows between EU and MERCOSUR countries are likely to rise. Spanish policy makers and agricultural sectors present growing concerns regarding this potential FTA related to possible social and environmental effects. According to the literature, beyond direct effects on trade, a free trade agreement can come with unintended consequences, namely in terms of environmental impacts. This paper explores the potential indirect effects of an EU-MERCOSUR free trade agreement in terms of greenhouse gas (GHG) emissions linked to the agri-food industries in Spain.
Our baseline model is based on the Global Trade Analysis Project (GTAP) multiregional input-output model (MRIO). We choose the GTAP MRIO model since it provides sufficient detail on agricultural and food processing sectors. The baseline MRIO is linked to a GHG emission coefficients set, thus accounting for direct and indirect emissions embodied in global trade. Upon the trade coefficients of our baseline MRIO we predicate an industry-disaggregated gravity model using information published by the Centre d'Études Prospectives et d'Informations Internationalis (CEPII). Using our calibrated gravity model calibrated, we estimate two hypothetical MRIOs based on estimated trade coefficients' sets. In model 1, we assume the existence of a free trade agreement between the EU and MERCOSUR countries covering only the agricultural and food processing sectors. In model 2, all sectors are equally affected by the free trade agreement. We measure how embodied emissions might vary for Spanish agri-food sectors between our baseline and hypothetical models. Moreover, assuming invariant GHG emission coefficients—i.e.: the FTA does not introduce less-polluting technologies—we decompose GHG emission variations in the agri-food sectors of our MRIO model using a structural decomposition analysis. We report effects linked to final demand shifts (namely household consumption), technological change and import substitution. Finally, we study how this potential environmental impacts might affect Spain in meeting her established goals on GHG emissions 'reduction in the short run.

Reindustrialization and Resource-Based Industries: Productive, Occupational, and Emission Linkages

Topic: Industrial Policies
Author: Gabriel Fraga PESSANHA
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In the last decade, industrial development and industrial policies have once again taken center stage in discussions. In the Brazilian context, the debate on industrial policy has gained traction under the aegis of the neoindustrialization proposed by the federal government, based on three premises: (i) strengthening the Brazilian industry is key to the sustainable development of Brazil from social, economic, and environmental perspectives; (ii) Brazil has been undergoing a process of early and accelerated deindustrialization since the 1980s, with a primarization of the production structure and shortening and weakening of supply chain links; and (iii) the country's exports are concentrated in low-technology complexity products, limiting Brazil's trade gains. (MDIC, 2024)

On the other hand, this discussion within the Brazilian context must be considered in light of the abundance of natural resources, the country's competitive advantages in these activities, and the industrial base related to these activities. In this perspective, the literature discussing the development trajectories of Latin America based on Natural Resource-Based Development (NRBD) strategies stands out. According to this literature (Pérez, 2010; Marín et al, 2015 Andersen et al, 2016), considering the revolution in technological patterns driven by ICTs and changes in the international scenario with the emergence of China, there would be a "window of opportunity" for Latin American countries to specialize and develop through the exploitation of

their natural resources.

One central aspect for assessing the role of a productive sector within the economic system is the evaluation of its production linkages, as outlined by Hirschman (1958) and Rasmussen (1958). The use of these indices is relevant because they can analyze the direct and indirect impacts of the Leontief input-output matrix in terms of the dispersion of its linkages and the sensitivity of these sectors to stimuli from the rest of the economy. However, this analysis alone cannot provide the patterns of interdependence among sectors, merely representing the effect of that sector on the entire economy. Therefore, it is important to understand not only their linkage effects but also their patterns of sectorial interdependence, allowing for a deeper understanding of the dynamics of this bloc and its potential in a reindustrialization scenario. Thus, it is useful to comprehend the relationships within the NRBIs bloc and also with other productive blocs in the economy, understanding their spillover effects and, given the circular flow of income, their feedback patterns.

Research Questions:

The present project aims to understand the production, occupational, and emission linkages within the analytical framework of NRBIs in order to contribute to the discussion on a reindustrialization strategy based on NRBIs. Associated with this question, we worked with the following hypotheses: (i) NRBIs exhibit similar linkage characteristics to the rest of the manufacturing industries in terms of interindustry production linkages; (ii) however, they constitute a more heterogeneous block than other industrial activities; (iii) the pattern of interdependence within this block carries greater weight for external effects beyond the block.

Data and Methods

The construction of three-dimensional linkage indicators—productive, occupational, and emissions—is based on the methodological framework of Pyatt and Round (1979), Stone (1985), Miller and Blair (2009), Costa and Freitas (2018), and Costa (2023). This involves decomposing the matrix block into different activity blocks capable of representing analytical linkages within NRBIs, as well as other industrial sectors and the remaining sectors. Furthermore, for occupation and emission data, SCN/IBGE and SEEG data will be processed and utilized in the I-O tables. Given that existing sectoral classifications for Brazilian activities do not precisely address the category of NRBIs, it became necessary to construct a definition considering the relative importance of natural resources for their intermediate consumption. In this regard, one of the contributions of this work was the classification of NRBIs based on the Intermediate Consumption of activities, grouping them into four categories: Agriculture, NRBIs, Manufacturing Industries excluding NRBIs (MIeNRBs), and Services and Public Utilities (S&PU).

Novelty of Research

This work not only presents a new classification for NRBIs but also innovates in the form of estimating the production linkages of sectors in the Brazilian economy. It employs a methodology that isolates different blocks within the economy, enabling the analysis of distinct patterns of interdependence among sectorial aggregates for dimensions that go beyond purely productive spheres.

Global Value Chains indicators fully consistent with EU official statistics

Topic: Trade and Global Value Chains Policies
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GVCs indicators can assist policymakers and businesses in understanding the changes in the global trade landscape, such as the growing significance of services, the emergence of regional value chains, and the potential vulnerabilities to trade disruption. Due to these reasons, Eurostat will annually produce and distribute Global Value Chains (GVC) type indicators for the EU and its primary trade partners, estimated using the EU Inter-Country Supply, Use and Input-Output Tables known as 'FIGARO' tables. The initial version of the FIGARO-based GVC-type indicators database will include 12 indicators grouped into six categories of varying complexity and coverage: i) Basic trade statistics, including gross imports and exports. ii) Value added in trade indicators (VAiT), encompassing domestic value added in gross exports and foreign value added in gross exports. iii) Trade in value added (TiVA) indicators, covering domestic value added in foreign final demand, and foreign value added in domestic final demand. iv) Resilience indicators, including forward and backward participation and GVC participation. v) Employment indicators, comprising domestic employment in gross exports and domestic employment in foreign final demand. vi) Other developments, referring to a new indicator called single exposure indicator (SEI), which is a combination of TiVA and VAiT to encompass all exported value added pathways.

The main innovation of this database is that these indicators will be calculated using two approaches: the national perspective and the EU regional perspective. The need for these two approaches is justified by the very nature of the EU project and the system of competence distribution. The key difference between the two lies in how intra-EU trade is accounted for, either as international trade (national perspective) or domestic trade (EU regional perspective). Consequently, each approach requires a different input-output model.

In the national perspective, Local Leontief matrices are utilized, which are based on a single-country input-output table, as represented by the expression L^rr=(I-A^rr)^(-1), where r is a country in FIGARO, and A is the domestic input coefficients matrix of that country. On the other hand, in the EU regional perspective, an EU single-region Leontief matrix needs to be obtained, which internalizes intra-EU spillover effects following R=(I-A^rs)^(-1) for r,s∈{EU}. However, this is not required for TiVA indicators and employment supported by final demand, which are based on the global Leontief matrix B=(I-A)^(-1). As a result, the difference between both approaches solely relates to the final trade products included. This means the regional perspective only includes no-EU countries, while the national perspective includes both no-EU countries and other Member States' final exports.

In this paper, we initially elucidate the calculation methods for each indicator based on the FIGARO tables for the period 2010-2021, illustrating how they are interrelated while conveying distinct messages for policymakers. Additionally, we outline the quality assurance methods developed to ensure that the main input-output accounting identities are maintained when computing the GVC indicators at full resolution. Furthermore, we highlight the principal variances from other approaches, such as the OECD TiVA's database or GVC indicators databases provided by specific EU member states. These differences pertain to the perspectives mentioned above, as well as other aspects such as how industries' value added is calculated, or the inclusion/exclusion of direct purchases abroad by residents when compiling exports and imports. We also expound on how limitations in data processing and distribution were overcome, and introduce new

terminology aimed at facilitating communication to a broader audience. Lastly, we briefly analyse the main results and EU trends following both perspectives, and outline the policy implications for the EU, including policies on open strategic autonomy.

Gender dynamics in employment associated with Brazilian international trade in Knowledge-Based Services (KBS): an analysis of total and bilateral trade with South America in 2019

Topic: Trade and Global Value Chains Policies
Author: Kethelyn PINTO
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Depending on how women and men manage to insert themselves into society, an intensification or retraction of export and import flows in an economy can affect them in different ways. Consequently, changes in international trade can directly or indirectly impact gender inequalities, calming, reinforcing, or perpetuating them.
The paid labor market is one of the privileged loci to discuss the impacts of changes in international trade flows on society and the well-being of its population. This occurs because, in a country, part of the jobs are associated with trade flows, whether those generated by exports or those threatened by imports. On the one hand, the production of exported goods and services generates direct and indirect jobs, and, on the other hand, the sectors most sensitive to import competition may contract, threatening the jobs associated with them (ECLAC, 2021b; FONTANA, 2020).
From the point of view of value-added, trade flows and the labor market, the services sector stands out for its importance to the Brazilian economy. In 2019, the sector was responsible for more than 70% of the country's gross value added, respectively 12.0% and 20.3% of total exports and imports, and concentrated 85.7% and 61.3% of jobs for women and men in the Brazilian economy.
Furthermore, recent transformations in the organization of production in economies with the profusion of global and regional value chains make the service sector, mostly Knowledge-Based Services (KBS), even more intertwined with industrial and agricultural activities. In other words, because of these transformations, the outsourcing of several activities that were previously carried out within an organization/company has occurred, the separation between industry and trade has become more tenuous and the service content in manufacturing production has grown. significantly – to what is conventionally called the “servitization” of manufacturing (ILO, 2019).
Likewise, it is also worth noting that several authors (such as, for example, BRESSER-PEREIRA, NASSIF and FEIJÓ (2016)) consider that certain service subsectors – those “technologically sophisticated marketables” – play, along with high-performance sectors, technological content, a strategic role in development because they have a high added value per capita and remunerate their workers with high salaries.
Recognizing these facts, the objective of this work is to estimate and analyze the content and profile of female and male employment associated with the Brazilian international trade in KBS in 2019, in quantitative and qualitative terms, seeking to answer to what extent gender inequalities in the Brazilian labor market are reproduced in this context. Given the importance of South America as a trading partner (a partner that is the destination of approximately 11.9% of Brazilian exports and the origin of 10.1% of its imports), we will compare the volume and employment profile associated with total international trade with that associated with bilateral trade with South America.
The methodology used to calculate the employment content associated with total and bilateral exports and imports with South America is based on studies such as CASTILHO (2007), KUPFER,

FREITAS and YOUNG (2003) and ECLAC (2021a; 2021b; 2022) and It is detailed in FERREIRA (2022). The data used for such estimation are the Input Output Matrix estimated for the Brazilian economy by ALVES-PASSONI and FREITAS (2020), data from the labor market, from the Brazilian Household Survey (Pnad contínua), and international trade, available in SISCOMEX and SISCOSERV. Furthermore, to qualify jobs, an Employment Quality Indicator (EQI) is calculated, disaggregated by sex, where we group the following variables, coming from the continuous PNAD, into a synthetic indicator: remuneration per hour worked, participation in management positions, the proportion of people formally employed, length of time in the position and participation of women (or men) in the sector. For all these variables we understand that the higher their values, the better the job characteristics will be for the workers. These indicators are averaged and the IQE is obtained by sector, allowing comparison between sectors and indicating which ones have higher quality jobs. Subsequently, we calculate an indicator weighted by the total sectoral employment of the economy, associated with exports and imports. In this case, the female and male QEI associated with exports, imports and total employment is compared.
The main expected results are to present stylized facts that contribute to arguing that greater Brazilian regional integration with South America cooperates to reduce gender inequalities in the paid labor market associated with Brazilian international trade, with emphasis on the KBS sector.

Energy transition and the impacts on households – a modelling approach

Topic: Special Session: Integration of energy systems models and economic models: advances and applications
Author: Jan PLASSENBERG

The ongoing energy transition is a process of moving away from fossil fuels towards the use of sustainable, renewable energies in all sectors of the economy and answer the question to what extent households are influenced along the journey. The spectrum of the energy transition begins with energy production and ends with energy consumption. Both components will have to undergo significant changes for a successful energy transition. Private households play a significant role in this, both as labor forces and consumers. In this presentation, we will therefore look at the role of households on the path to a sustainable and resilient economy.
In the production of energy, the households appear as a workforce - and not only as electricians or for the installation of photovoltaics - development, planning, approval, maintenance and other tasks must also be considered. Energy production alone therefore leads to massive changes in the industry structure.
Private households also play an essential role in energy consumption. They account for a relevant share of energy consumption worldwide. In addition, they have to pay for the energy transition. Either directly through higher prices for energy and mobility. Or indirectly through increased prices for goods or government levies. These changes in additional energy costs affect different households in different ways. For example, energy costs play a proportionately greater role in the consumption basket of lower-income households. Ac-cordingly, these households feel changes in prices more strongly and have to adjust their consumption structure more significantly.
The need for a modelling approach arises from the consideration of these interdependent dynamics. A change in the industry structure inevitably leads to a shift in labor supply and demand. Wage trends do not remain unchanged. The income side of private households shifts. However, changes in energy prices also affect households in their consumption structure. For example, increased energy prices can lead to crowding out effects on other consumer spending due to a lack of substitution options.
The energy transition therefore affects private households in a number of ways, including in

contradictory ways. A model approach is required to describe, analyze and, at best, forecast this development. One that places the necessary energy transition in the context of current economic developments (supply chains, interest rate changes, etc.).
The integration of the specific issue of the energy transition and the influence on households is conducted through interaction with the macroeconomic input-output model IN-FORGE. The name is derived from INterindustry FORecasting GErmany and provides the macroeconomic development for Germany. It takes into account circular relationships between private households, NGOs, companies and the state. Furthermore, the input-output approach makes it possible to map not only the direct effects of the energy transition. Indirect or induced effects along the value chains are also taken into account. The energy transition has a significant influence on wage setting in certain sectors. The changing wages influence prices, which in turn have an impact on the consumption structure of private households.
This sector-specific wage development is crucial for extrapolating the incomes of the various households. For this purpose, a data set from the German Federal Employment Agency is also used to allocate the sector to which the individual households belong and to extrapolate wage trends for each household.
The consumption structure is determined on the basis of the Germany Federal Statistical Office's "Income and Consumer Panel". Household expenditure is also extrapolated using the INFORGE model in order to take account of the circular relationships between transformation and macroeconomic development.
As shown, households therefore play a decisive role in many respects in enabling the transformation towards a sustainable and resilient economy. A model approach that accompanies the transformation process from the perspective of households therefore is important but has so far been largely neglected in research. The results can provide important information for giving the best possible advice to key stakeholders in the areas of politics and business.

Evaluating the Macroeconomic and Environmental impact of India's Ethanol Blending Programme - An Input-Output Framework

Topic: YSI and Development Programme I (Discussant: S. Kagawa and R. Bardazzi)
Author: Vishnu Sivadasa PRABHU
Co-Authors: Kakali MUKHOPADHYAY

India has set an ambitious target of achieving Net Zero emissions by 2070 which is also aligned with SDG 7 and 13. Currently, the road transport sector constitutes the second largest share of GHG emissions in the country and to this end, the Indian government has set a short-term decarbonization strategy of achieving 20% ethanol-blended fuel (E20) by 2025 under the Ethanol Blending Programme (EBP). Using the 140x66 Indian Supply Use Table (SUT) 2018-19, the study evaluates for the first time the economy-wide impact of EBP in different scenarios by introducing a to new industries (Ethanol and E5) and three new commodities (Ethanol, E5 and CO2) in the original Indian SUT. The environmental footprint analysis resulting from the ethanol industry expansion is also conducted. Results show that EBP leads to positive macroeconomic impact across Total Output, GDP and Employment by 0.197%, 0.132%, 0.175%, respectively while there is a minimal, yet net-negative impact resulting from reduction in petroleum production industry. The sugar-based distilleries supply-chain benefit the most compared to grain-based distilleries since 84% of ethanol is being produced from the former. In pursuit of India’s long-rum target of carbon emission reduction of 1 billion tonnes by 2030, E20-blended fuel will contribute to 3.6% of the total emission reduction, while in combination with a greener power sector will lead to 34% GHG reduction.
Keywords: Ethanol, E20, Sugarcane, Wheat, GHG emissions, Net-zero

Economic Impact of FDI, Tourism, and Remittances using CGE Analysis: The case of Fiji

Topic:
Author: Stephen PRATT

Tourism, remittances and foreign direct investment are all external injections into an economy. However, the transition mechanism through which these external injections flow through the economy differ. Hence, they will have different impacts and affect different parts of the economy to varying degrees. While these three injections are not mutually exclusive, that is, there is no need to choose to specialize in tourism, remittances or foreign direct investment; it is of interest to policy makers to determine which avenue of external funds has the largest economic impact and who benefits the most from each mode of expenditure injection.

Small Island Developing States (SIDS) face many economic challenges due to their environmental and geographical characteristics (Feeny, Iamsiraroj, & McGillivray, 2014). These challenges result in economic vulnerability and threaten residents' standard of living. These island states have by definition, small, meaning land and fresh water supplies are in limited supply (McGillivray, Naudé, & Santos-Paulino, 2010). This means that they have a limited ability to diversify their economic base and hence have a strong dependence on a narrow range of exports. It also means that they have a high import propensity, particularly of strategic goods such as food and fuel, whose prices have exhibited high volatility (AusAid, 2006). They tend to be geographically remote, away from major markets and trading partners. This means what they do export is subject to high transportation costs, weakening their competitiveness (United Nations, 2017). Their ecology tends to be fragile and they are often located in areas that experience a high rate of natural disasters and are threatened by climate change (Robinson, 2018). These countries also have low populations, especially working adult population so that they lack of economies of scale.

Since tourism, FDI, and remittances can be susceptible to both internal (political, security, and natural disasters) and external shocks (foreign exchange market and international economic conditions), it is important to understand the extent of the impact and the vulnerability of these sectors for the economy. As a result, prudent policy measures can be taken to minimize their potential adverse effects, to maintain macroeconomic stability, and achieve long-term sustainable development of the economy.

There are few studies on the role of tourism, remittances and FDI in the same piece of research to allow direct comparisons. Therefore, this paper contributes to the research gap and gauge the discussion on the role and sensitivity of these sectors to domestic economy, using a CGE model. The CGE model for Fiji has been revised with the newly estimated input-output table (Oum & Singh, 2019).

We conduct simulations under two scenarios. The first scenario is for the economy-wide impact of 10% increase in exports of tourism sector, remittances, and FDI inflows under the fixed real wage, assuming sticky or wage rigidity. The second scenario of simulations is conducted with endogenous real wage and supply of labor, allowing for the potential backward-bending labor supply curve, that is, a reduction in labor supply due to an increase remittances (non-wage income) and wage, and the "Dutch disease" (Corden & Neary, 1982)

Net jobs generation and net GHG emissions reduction from biogas partially replacing fossil fuels in Southern Brazil

Topic: Energy Policies
Author: Maria Priscila RAMOS
Co-Authors: Gustavo Adolfo FERRO, carlos adrian ROMERO

The move towards renewable energy sources can imply complementarity or substitution of conventional sources. If the links between both sources were strictly complementary, and the renewables started from scratch, jobs created in this new sector would be additional to existing jobs in the conventional energy industry. However, if renewable energy is going to substitute partially conventional energy, jobs in the renewable energy sector would replace part of the jobs in the conventional energy sector. Same, if conventional energy sectors yield certain levels of GHG emissions and it is replaced partly by a cleaner energy, the net GHG emissions would decrease at the whole economy level.
We explore the reach of net job creation and net GHG emissions reduction from the partial substitution of conventional energy sources by biogas in Southern Brazil. Biogas is generated from substrates derived from agriculture and cattle, agroindustry, urban solid waste, and sewerage treatment. The Southern Region of Brazil is made up of the states Paraná, Santa Catarina, and Rio Grande do Sul. Fossil fuels are globally responsible for more than 70 percent of GHG emissions and part of the solution of the global warming is their replacement with renewable energies.
Brazil is a middle-class country, with an industrial base, the tenth GDP by size in the world. Brazil has an energy matrix relatively clean, with an important share of hydroelectricity, and a great potential for biogas production (the current production is around 3.4% of the estimated potential). According to the targets in the Brazilian National Determined Contribution to Paris Agreement, the country aims to reach a 45 percent share of renewable energies in its energy matrix by 2030.
The measurement of socioeconomic impacts in each economy helps assess clearly and in detail all the social costs and benefits of a certain sector’s expansion or reduction. To account for production and industrial chain relationships, Input-Output analysis offers good clues to measure a sector’s expansion impact. Nevertheless, two problems arise: first, newly developed sectors could be not present in statistics, normally devised with a limited degree of disaggregation; and second, regional statistics in developing countries can be inexistent, incomplete, obsolete, or incoherent with national statistics. Part of the task to achieve the goals of determining net job creation and net emission reduction consists of providing disaggregated, consistent, coherent, and updated regional Input-Output tables and models.
Concerning jobs and GHG emissions, Input-Output tables and models are expressed in monetary units, while employment is measured by jobs and GHG emissions are in tCO2eq. Our contribution uses hybrid approaches for regionalizing matrices, opening inexistent entries in the Input-Output tables, and adding satellite accounts to compute net jobs and GHG emissions.
Once the baseline has been established, we consider different scenarios of fossil fuel substitution by biogas. We hypothesize that net job creation will be positive because biogas industries are more labor intensive than fossil fuel energy generation and that net GHG emissions will be negative since biogas industries generate lower emission levels than conventional energy sources. Scenarios were devised on moderate assumptions concerning the demand and supply of biogas, the potential supply of substrates, and degrees of substitution achieved between fossil and biogas energy sources.
However, caution is needed in advancing conclusions. The (partial) substitution of fossil fuels, demands several adjustments in the infrastructure of electricity generation, and public policies to help the market develop.

Results are useful to develop public policies (command and control -regulation- as well as incentive ones -taxes and subsidies-) to encourage changes in the energy matrix aimed at increasing net employment and decreasing net GHG emissions, based on evidence, and avoiding partial (sectoral) arguments which can be distributive.
Jobs in biogas industries are sparse in the territory because of the nature of some biogas industries. Part of the production could be centralized in big cities, such as the one coming from solid waste processing, or from industries with great scale economies, such as beer, while several small or medium-sized industries and agricultural enterprises can also produce biogas from their substrates. Thus, jobs will be generated in the whole territory of the states involved. GHG emission reduction, in turn, will help achieving international commitments to control global warming.
Our analysis is based on sound methods, and updated and homogeneous statistics, and tries to address all relationships of complementary and substitution among sectors to avoid partial reasoning in favor or against certain sectors. We rest on empirical evidence and moderate assumptions on technical conversion factors.

A Hybrid Energy Input-Output Matrix for Brazil: Analyzing Energy Sectoral Pressures and GHG Emissions

Topic: Energy Policies
Author: Carolina SILVA RIBEIRO
Co-Authors: Roberto Maximiano PEREIRA

Estimates from the Intergovernmental Panel on Climate Change (IPCC) show that human activities could cause about 1.0°C of global warming above pre-industrial levels and warming is likely to reach 1.5°C between 2030 and 2052, if it continues to increase at the current rate. Currently, estimated global anthropogenic warming is increasing by 0.2°C per decade, considering past and current emissions, warns the IPCC. The consequences of climate change caused by global warming pose risks to humanity and natural ecosystems, highlighting the importance of an energy transition. In this context, contributions arising from population growth, increased food production and economic growth contributed to energy consumption and, in turn, to greenhouse gas (GHG) emissions. Therefore, this work analyzes the structural changes in the Brazilian economy in relation to pressures in the energy sector and pollutant emissions. To this end, the methodology used consisted of using a hybrid input-output model with energy data (physical flows) from the National Energy Balance (BEN), based on input-output matrices estimated for Brazil, between 2000 and 2015, and data from the Greenhouse Gas Emissions and Removals Estimation System (SEEG). The analysis will be based on two parts. The first will be based on the hybrid energy consumption model that will allow checking the direct, indirect and total requirements of the energy sector. In the second part, we will observe the behavior of the energy sector and other sectors of economic activity in Brazil, in relation to GHG emissions. The results obtained will allow a better understanding of the energy sector in Brazil and its participation in the level of emissions given a global agenda to combat climate change.

Keywords: Energy; Input-output; Hybrid models; GHG emissions.

Interdependence between the tourist regions of Sergipe, Brazil

Topic: Regional Analysis
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Recent years have begun to show a scenario of world recovery in tourist activity, which had been severely affected by the COVID-19 pandemic. In 2019, according to the World Travel & Tourism Council's annual Economic Impact Report (EIR) data, tourism accounted for 10.3% of the world's Gross Domestic Product (GDP). In 2021 and 2022, however, this share dropped to 6.1% and 7.6%, respectively, which is still below the pre-pandemic levels. Brazil, an important tourist destination in South America, was also severely impacted by the pandemic. Ribeiro et al. (2021) estimated a 31% drop in the GDP of Brazilian tourist activities in 2020. In this present scenario of recovery in the sector, the existence of based on concrete planning instruments is fundamental. Tourism is an important development alternative for poorer countries or regions. In Brazil, tourism has already been used explicitly as a regional development policy through PRODETUR Nacional, specifically in the Northeast region - PRODETUR NE I and II. Studies by Haddad et al. (2013) and Ribeiro et al. (2017; 2022) show that tourism reduces regional inequalities in the country. The scarcity of resources in poorer states, often located in peripheral regions, contributes to the fact that tourism policy is not a priority in state public management, as is the case of Sergipe, located in the Brazilian Northeast. Sergipe is the smallest state in the country in territorial terms and accounts for 4% and 0.6% of regional and national GDP, respectively. Although the state has tourism potential in several segments (sun and beach, adventure, and historical-cultural), they are not fully exploited. Constructing tools that can aid tourism planning is fundamental for tourism development. Thus, this paper aims to build an inter-regional input-output (IO) system for Sergipe's tourist regions and identify the contribution of Tourism Characteristic Activities (TCAs) to the state economy. By employing an inter-regional input-output (IO) system, the study avoids potential overestimations of the economic contribution of tourism by disaggregating TCAs. This methodological insight not only enhances the precision of the findings for Sergipe but also provides a valuable approach for regions and countries globally facing similar challenges in accurately assessing the economic impact of tourism. The study's focus on trade flow dynamics, value-added concentration, and employment multipliers within different tourist regions of Sergipe adds depth to the understanding of the economic intricacies of the tourism industry at a regional level. Moreover, identifying key sectors provides tangible insights for policymakers and researchers promoting sustainable tourism development. While the research refrains from making explicit cross-regional or cross-national comparisons, its emphasis on precise regional data offers a rich foundation for future comparative studies. Additionally, the research highlights the need for tailored policies in Sergipe, leveraging regional production chains. This focus on practical applications adds depth to the broader international discourse on effective tourism planning and development, making it pertinent to a global audience of researchers, policymakers, and practitioners navigating the complexities of regional economic recovery and growth. Despite efforts in the national literature to assess the productive interdependence of TCAs in Brazil, no study simultaneously deals with the regional and sectoral specification of tourist activities. Our main contribution, therefore, is: i) to regionally disaggregate the weight of trade flows from tourist activities and ii) to provide a tourism planning tool for Sergipe to encourage tourism development. In other words, this paper offers an unprecedented database for Brazil and Sergipe by sectorally and regionally disaggregating tourist activities. The method for estimating tourism can be replicated in countries and regions without a Tourism Satellite Account, such as Brazil. The disaggregation of the TCAs avoids overestimating the effects of tourism on the state economy. The main results estimate that TCAs in Sergipe accounted for 1.53% of the state's gross value

added (GVA) in 2015, 3.7 times lower when considering only tourism activities. The Polo Costa dos Coqueirais stands out among the tourist regions, particularly regarding the distribution of TCAs' GVA within the state. Tourist road transportation is considered a key sector in all tourist regions.

Innovative technologies for steel manufacturing: extending Exiobase to analyze decarbonization paths to reduce steel carbon footprint within the European Union

Topic: Special Session: Supply chain on critical raw materials
Author: Lorenzo RINALDI
Co-Authors: Debora GHEZZI, Matteo Vincenzo ROCCO

Steel is a crucial material for the manufacture of clean technologies and electrical infrastructure. However, steel production is a very energy intensive process, responsible for around 8% of global CO2 emissions. With the intensification of the net zero by 2050 target declared by the European Union, strengthened with the Fit-for-55 and REPowerEU policy plans, exploring innovative solutions to reduce the environmental impact of heavy industries is of utmost relevance. The aim of this work is to model the supply chains of new steelmaking technologies and study long-term decarbonization scenarios of the steel sector. The analysis adopts the open-source software MARIO to extend the hybrid-units Exiobase supply-use database to account for innovative steel manufacturing technologies. In particular, the technologies considered encompass the Optimized Conventional Blast Furnace-Basic Oxygen Furnace (BF-BOF) route, including hydrogen (H2) injection, charcoal injection, CCUS, and charcoal injection with CCUS, and the Direct Reduction (DR) route, exploring natural gas and hydrogen direct injections. In relation to H2-based technologies, if following BF-BOF route, they use a combination of grey (20%) and green H2 (80%); a sensitivity analyses was performed on this mix. On the other hand, natural gas-injected DR technology only uses grey H2, while hydrogen-injected DR technology is fed by green H2. The penetration of these technologies was explored according to scenarios resembling European 2030-to-2050 targets, enriched to account for the power sector decarbonization. The results show a reduction in the carbon footprint of steel across all scenarios, ranging from -9% to -24% in 2030 to -62% in 2050. However, it is worth noting that the share of emissions related to electricity production increases, so the extent of the footprint reduction is highly dependent on the share of renewable energy in the European electricity mix. The parameter has the greatest impact on green-hydrogen-based processes, particularly DR technology for which the 2022 electricity mix leads to an overall impact of 2.03 tonCO2/ton steel, while a 100% renewable or nuclear mix would lower it to 0.7.

Hydro-economic equilibrium with climatic variability in a subregional input-output framework: the case of Tuscany

Topic: Energy policies
Author: Benedetto ROCCHI
Co-Authors: Renato PANICCIA', Benedetto ROCCHI

An interregional IO model of a regional economy (Tuscany, IT) extended to water resources is used to provide an economic assessment of water resources overexploitation. A comprehensive representation of the interdependencies between hydrological and productive systems, allows to define a set of endogenous thresholds of water scarcity and the conditions for the

hydro-economic equilibrium of the regional economy. Despite only 24% of the annual supply of freshwater is used for production, on average about 172 Mm3 of water are used in condition of scarcity, due to a spatial mismatch between supply and demand. The opportunity cost to reach the absence of overexploitation in all sub-regional areas would be 129 Euro for each m3 of water used in condition of scarcity. Hydro-economic equilibrium would require a decrease of about 10% of the regional output, a value that would be increased to 14% in a climate change scenario.

Consistent integration of energy, macro-economic and households demand systems models: conceptual definition

Topic: Special Session: Integration of energy systems models and economic models: advances and applications
Author: Matteo Vincenzo ROCCO
Co-Authors: Rossella BARDAZZI, Leonardo GHEZZI, Renato PANICCIA'

The success of the energy transition depends on the definition of reliable long-term investment planning strategies. Formulation of technically feasible and economically consistent energy transition pathways must be determined based on adequate modelling frameworks, including the engineering complexity of the energy system on one hand and, at the same time, providing a realistic representation of the economic dynamics, capturing feedback induced by structural technology changes and consumption habits in future scenarios.
This paper provides a proof-of-concept model of a consistent bi-directional integration between an energy and economic systems models.
Specifically, the energy system optimization model provides a comprehensive description of the national energy system, hence defining technically feasible structural changes in all national segments in future scenarios. Changes in technology capacity stock and energy carriers supply are then passed to economic models.
Macro-economic Stock-Flow-Consistent (SFC) model is upgraded with a microsimulation demand model focused on households consumption, estimating elasticities at household-type level and including financial variables. A linkage between the microeconomic analysis and the personal consumption demand system is embedded in the SFC model, returning to the energy system model the corrected yields of demand of energy carriers and new constraints on investments.
Once fundamental scenario assumptions are defined (available technologies, related costs, policy constraints, ...), the two models run and exchange the related endogenous parameters until convergence is reached.
The significant deviation of results obtained by the integrated model compared to the energy and economic models working in isolation demonstrates the meaningfulness of the proposed approach in modelling future scenarios.

Renewable and Non-Renewable Energy Embodied in International Trade

Topic:
Author: Filipe Vasconcelos ROCHA
Co-Authors: Fernando Salgueiro PEROBELLI, Weslem Rodrigues FARIA

In a context of increasing international economic integration, strengthened by the process of international production fragmentation, that is, by the spread of global value chains. Therefore, considering the exporting country (seller of the final product) as solely responsible for all the

environmental impact produced by this product, emerges as a conclusion that may bias the results.
In this way, as it is difficult to observe a comparison between the environmental contributions of different countries in international trade, it is opportune to observe in the periods of 1996 (a relatively early stage of global value chains) and 2016 (near the peak of the development of international production fragmentation), what are the divergences between regions in terms of the participation of countries and regions of the world in the virtual trade of renewable and non-renewable energy. It becomes even more relevant in this observation to take into account the different energy matrices that exist, as well as the effective participation in the production of goods traded internationally, in order to avoid the bias mentioned earlier.
Through this work, the aim is to understand the distinct participation of each country in the virtual trade of these energies, as well as to investigate, even if succinctly, the presence of asymmetries between international environmental pressures exerted (suffered) by important players in trade in contrast with the actual energy patterns of the productive matrices aimed at exporting goods and services from these regions under analysis.
For the analysis, the EORA26 database was used, which contains input-output matrices and satellite accounts for 190 countries with 26 sectors for the period from 1996 to 2016 (free academic tier). Data such as intermediate consumption, final demand, and satellite accounts were used to form an aggregation resulting in the input-output matrix EORA26-30, which includes 16 regions, 14 countries, and 26 sectors. Satellite accounts were used to create two vectors, each for a part of the analysis, one for renewable energies and the other for non-renewable energies, both measured in terajoules. Specifically, for renewable energies, the accounts used were “Hydroelectric Electricity”, “Geothermal Electricity”, “Wind Electricity”, “Solar, Tide and Wave Electricity” and “Biomass and Waste Electricity”. For non-renewable energy, the accounts used were “Natural Gas”, “Coal”, “Petroleum” and “Nuclear Electricity”.
The methodology employed was applied to both types of energy considered. For both, the level of embodied energy in intermediate transactions per region with the rest of the regions was examined, as well as the portion of this embodied energy in total demand per region, resulting in embodied energy in transactions from one region to another. Thus, when done for all regions, it results in a matrix with 30 rows and columns, with 900 observations, where the main diagonal represents the energy used in the internal process of the country, while the others represent the energy embodied in international trade. By removing the values from the main diagonal, the rows of this matrix represent the embodied energy exported, while the columns represent the imported energy, where each row and each column represents a region. With this result, it was possible to find the net exports/imports of renewable and non-renewable energies from the regions under analysis for the periods of 1996 and 2016 from the EORA26-30 matrix.

A SFC-IO Analysis of Greece's Economy in the Wake of Internal Devaluation

Topic: Special Session - Assessing Industrial, Trade and Green Transition Policies Through SFC-IO Models
Author: Nikolaos RODOUSAKIS
Co-Authors: Christos PIERROS, George SOKLIS

This study introduces an empirical and theoretical framework that integrates Stock-Flow Consistent (SFC) modeling with Input-Output (IO) analysis, specifically tailored to investigate the economic adjustments in Greece following the initiation of internal devaluation measures in 2009. This period marks a significant shift in Greece's economic policy, aimed at enhancing competitiveness and restoring fiscal stability. While traditional SFC models have been

instrumental in analyzing demand-driven aspects of the economy, emphasizing macro-financial dynamics, they have largely overlooked the complexities associated with the supply side. Our framework addresses this gap by incorporating IO analysis, thereby enriching our understanding of the economy's structural and productive dimensions.

This approach allows for an in-depth examination of the principal challenges that have emerged in the Greek economy, such as increased indebtedness, widespread unemployment, and structural vulnerabilities. It further explores the impact of austerity measures, including wage reductions, pension cuts, and the downsizing of the public sector, on the macroeconomic and financial spheres. Through detailed sectoral analysis, the study facilitates an exploration of the interactions among various sectors and economic agents.

Merging SFC and IO methodologies, this paper presents an analytical tool for stakeholders, including policymakers, economists, and scholars, enabling the development of more nuanced and effective economic policies. It provides a holistic and dynamic overview of the Greek economy's evolution in response to austerity and internal devaluation, leveraging data from the Organisation for Economic Co-operation and Development (OECD) and the Hellenic Statistical Authority (ElStat). So, this study underscores the critical link between policy measures and economic outcomes, offering key insights for informed policymaking.

Total Factor Productivity Surplus and Constant Input-Output Multipliers

Topic:
Author: Davide ROGNINI

The study of economic multipliers represents a fundamental element in economic analysis, providing an advanced analytical framework that allows one to understand and evaluate the impact of any shock on the economic activities of any country. Input-output (I-O) multipliers focus on interdependencies between sectors and how changes in one or more of them may produce effects on others and spread throughout the whole economy. In this sense, the key to interpreting I-O multipliers is understanding that they represent the proportion by which a shock in a certain input or output component of the supply or demand triggers changes in the economy’s total output.
Traditionally, academia focused on nominal I-O multipliers. However, in the last few decades, there have been attempts to reproduce and use physical or constant I-O tables instead of ordinary monetary or nominal I-O tables for several reasons, such as a better understanding of structural and technological change or avoiding price-biased results. Multiple applications of constant price I-O exist; however, the commonly accepted technique to obtain constant tables is the double deflation approach. While academia recognizes the flaws of double deflation and already provides valid alternatives, all substitutes are grounded on what we consider inaccurate theoretical premises: the notion of balanced I-O tables. We believe that any method based on this assumption does not appropriately meet the requisites of constant impact analysis as it would challenge the definition of structural change, according to which a constant price system of accounts is unbalanced by nature. This disequilibrium is the source of productivity gains.
The present paper addresses the issue of constant impact analysis by proposing the single deflation method in which productivity gains (total factor productivity surplus, TFPS) play a fundamental role in determining the effect of any shock in the economy. In this sense, we apply single and double deflation to the Spanish 2016 I-O tables for 2010-2016. We then analyze the differences between our proposed alternative and the standard method, observing that the

differences between the two approaches appear quite significant depending on the sector. These results refute previous literature that tends to consider the differences between nominal and constant applications negligible.
Moreover, we put forward a new I-O multiplier, the TFPS multiplier, that will compute the effect of a shock in demand in the distribution of total factor productivity among sectors. Finally, we provide a reinterpretation and extension of the TFPS identification methodology, expanding and detailing its study from 9 to 64 economic sectors.

Employment and income distribution in global supply chains: The case of South America

Topic: Trade and Global Value Chains Policies
Author: Hernan Alejandro ROITBARG
Co-Authors: Gabriel BRONDINO, Ariel Luis WIRKIERMAN

The global production landscape has undergone significant changes in the last century. Institutional reforms and technological improvements have contributed to the so-called "fragmentation of production". Production tasks are performed by numerous geographically dispersed firms, leading to the emergence of global supply chains. From the countries' point of view, specialisation is no longer in finished products but in a specific set of activities that contribute to producing one or many of the latter.
Studies on Latin America have reached a consensus on two important aspects of the region's participation in production fragmentation. Firstly, Latin America's participation in this process is relatively low and heterogeneous. South American countries predominantly participate as natural resource providers. In contrast, Central American countries and Mexico are primarily involved in the final stages, such as manufacturing assembly and providing information/computer and communication services. Secondly, the factors influencing this low participation can be classified as technical, geographical, and institutional. Technical aspects are related to the production function of natural resource extraction and exploitation, which is hard to 'unbundle'. Geographical factors include natural barriers such as the Andes and the Amazon, which affect regional transportation and communication, and the long distance to the top production and consumption centres in North America, Europe, and Asia. Institutional factors such as higher real wages and poor infrastructure quality also play a role.
Despite the growing evidence about the extent and type of participation in production fragmentation for Latin American countries, little attention has been paid to the distributional and employment profile associated with the alternative types of engagements in supply chains. How does income distribution change according to the kind of chain considered? What functions of employment are related to each type of engagement? Does the employment profile explain the differences in income distribution? What role does the destination of the final output play?
To answer these questions, we employ a Global Input-Output Model. From a single country's point of view, we consider final external demand and distinguish six components within it according to the location of production (domestic, within and outside the region) and the destination of the final output (within and outside the region). We analyse functional income distribution, average unit wage and employment structure induced by these sources of external demand.
The data employed is the 2021 edition of OECD Inter-Country Input-Output (ICIO) Tables. Additionally, we use data from household surveys. We study the cases of Argentina, Brazil, Chile, Colombia, and Peru for 2018.
We show how the reinforcement of South America's historical trade pattern based on primary activities during production fragmentation has affected its income distribution and employment. Unit wages and labour compensation shares in global value chain income are relatively low in

South American countries. Moreover, the source of external demand influences distribution differently. Trading with East and Southeast Asian countries is more favourable to countries belonging to the so-called Pacific Alliance (Chile, Colombia, and Peru). In contrast, it is less favourable to Mercosur countries (Argentina and Brazil), a remarkable insight to consider given the growing presence of China in the region. Finally, integration levels into regional supply chains are relatively low. However, it can potentially improve income distribution and raise wages since the production induced involves sectors and employments of higher technological complexity.

Gross Ecosystem Product in macroeconomic modelling

Topic:
Author: Bartlomiej ROKICKI
Co-Authors: IOANNA GRAMMATIKOPOULOU, Willem-Jan VAN ZEIST

Gross domestic product (GDP) shows the total value of output/income generated in a country. Commonly used as a main economic development indicator, GDP fails to capture fully the contributions of nature to economic activity and human well-being. The benefits provided by ecosystem services, such as crop pollination and water purification, are of great importance to any economy, both directly and indirectly. Nature inclusive decision-making requires that such benefits are taken into account in the economic decision-making process. Hence, Ouyang et al. (2013) proposed and further developed (e.g. Ouyang et al. 2020) the concept of Gross Ecosystem Product (GEP), which summarizes the value that ecosystem services provide to the economy in monetary terms. The Gross Ecosystem Product (GEP) is a measure that quantifies the contribution of final ecosystem goods and services to the economy. GEP highlights the importance of ecosystem services and allows overcoming the current bias in decision-making in favor of GDP growth.
This paper introduces the new GEP module in the macroeconomic model MAGNET. MAGNET is a GTAP-based global CGE model used to assess the policy impacts on the economy. MAGNET's endogenous land supply and forestry representation makes this model particularly suitable for this task, as does its international dimension. Built upon the INCA database on monetary value of ecosystem services, the new GEP module allows for comparison of the impact of different policies on both GDP and GEP in the European Union. The paper provides an example of the practical application of the GEP module. In particular, we apply a forward-looking policy scenario that assumes a significant change in consumption patterns. The results of preliminary simulations show that such an impact can significantly differ both between GDP and GEP and across particular ecosystem services.

Enhancing Climate Change and Energy Transition Policy Design through a Flexible Input-Output Simulation Model applied to Argentina

Topic: Energy Policies
Author: Exequiel ROMERO GóMEZ
Co-Authors: Maria Priscila RAMOS, carlos adrian ROMERO, Juan Ignacio MERCATANTE, Maria Laura OJEDA

Motivation
Designing and evaluating potential impacts of climate change and energy transition policies aligned with climate change international commitments requires a dynamic and adaptable

simulation tool to support policymakers in the current changing context. Each policy formulation and simulation requires the management of intricate interactions of factors for a comprehensive understanding of direct and indirect effects across sectors. To address this technical need, we propose a novel approach by constructing a flexible simulation model within an input-output framework.

Case study

To demonstrate the practical application of this simulation tool, we examine the case of Argentina and calibrate the model to represent the base year in 2022. Argentina consistently commits to addressing climate change through key international agreements, such as the United Nations Framework Convention on Climate Change, the Kyoto Protocol, and the Paris Agreement. These agreements signify Argentina's acknowledgment of the imperative to implement measures curbing global temperature rise and mitigating climate change's adverse impacts on its population's well-being.

This commitment is evident in tangible actions and policies integral to Argentina's sustainable and equitable development strategy. Examples include the Nationally Determined Contribution, the National Action Plan for Energy and Climate Change (2017 and 2019), and sectoral plans (2019) from the National Climate Change Cabinet. These plans encompass policies and actions targeting environmental pressure while considering economic impacts.

Objective

Aligned with climate change objectives, this paper aims to provide a friendly tool to help policymakers to assess cross-sectoral impacts of climate actions and to identify the most effective policies or projects to achieve these goals.

Methodological approach

The methodological tool developed for evaluating policies outlined in national sectoral action plans for climate change has several objectives. These include generating an input-output matrix with a suitable sectoral breakdown to assess environmental policies, constructing satellite accounts for employment, land use and greenhouse gas (GHG) emissions compatible with the Social Accounting Matrix (SAM), and developing a user-friendly simulation model. The input-output model developed is tailored to simulate sectoral policies aimed at reducing GHG emissions while evaluating their socio-economic impacts.

The tool’s key innovation lies in the calibration process, integrating an updated 69-sector SAM for Argentina in 2022, incorporating the aforementioned satellite accounts in a consistent manner. The model's granularity is enhanced by introducing crop-level disaggregation. By considering changes in the electric generation matrix, land use and productivity, the model captures a wide spectrum of potential policy interventions. Results emphasize effects on GDP, employment, tax revenues and emissions. Therefore, the tool developed is flexible enough to analyse the impact of the various climate change policies currently being considered thanks to its multi-sectoral disaggregation, its inclusion of potential price changes in some scenarios, through a pricing model, and the ability to estimate the impact of implementing multiple measures simultaneously.

Simulated scenarios and results

Among the simulated scenarios, we can mention:

- The change in the electricity generation matrix (allowing the modification of the electricity generation structure, including the investment requirements by generation technology implied by changes in generation, changes in the final demand for electricity, development of distributed generation, and improvement in landfill capture),
- The changes in land use (allowing the modification of the distribution of hectares to different crops and activities such as livestock and forestry, the incorporation of new hectares and

deforestation),
• The increase in biofuel cut and efficiency improvements in energy consumption by productive activities, among other scenarios programmed.
Among various simulations for reducing GHG emissions by 2030, trade-offs between GDP growth and emissions reduction are evident in scenarios like electricity generation matrix modification, carbon tax, and land use change. Nonetheless, certain scenarios, such as green hydrogen development, offer a dual gain with no trade-off between economic growth and emissions.
The simulation model is a potent tool for policymakers, providing a comprehensive understanding of diverse policy scenarios and their consequences. It enables the evaluation of direct and indirect effects, aiding informed decision-making in the pursuit of sustainable climate change and energy transition strategies. Despite focusing on Argentina's climate policies, this tool can assist others facing similar resilient challenges.

The Eurostat's FIGARO tables: upcoming 2024 release

Topic: Global Input-Output Accounts (GIANT): a collective initiative to harmonise input data entering ICIO tables published by international organisations (II)
Author: José M. RUEDA-CANTUCHE

Eurostat and the European Commission´s Joint Research Centre will present the latest improvements of the upcoming release of the FIGARO tables edition 2024.

Testing heterogeneity in ESUTs with econometric analysis

Topic: Special Session: Extended SUTs and IOTs - experiences and techniques of national statistical institutes and international organizations
Author: José M. RUEDA-CANTUCHE

This paper illustrates how firms data can be theoretically linked directly to multipliers without the need to compile input-output tables. This framework is appropriate for rectangular Supply and Use tables with more industries (broken down by size, ownership, etc.) than products, as is the case for Extended Supply and Use Tables. Therefore, by using firms data and the appropriate regressions, input-output multipliers can be derived econometrically, also testing whether those multipliers are significantly different across firms in terms of size, ownership, exporter status, etc. The outcome of this analysis can serve ESUT compilers as guidance for identifying those industries that would deserve additional efforts to break them down by size, ownership, etc.

Global Input-Output Accounts (GIANT): a collective initiative to harmonise input data entering ICIO tables published by international organisations

Topic: Global Input-Output Accounts (GIANT): a collective initiative to harmonise input data entering ICIO tables published by international organisations (I)
Author: José M. RUEDA-CANTUCHE
Co-Authors: José Elías DURáN LIMA

The GIANT initiative is an inter-agency network consisting of the Asian Development Bank (ADB), the European Commission (EC), the Organisation for Economic Co-operation and Development

(OECD), the International Monetary Fund (IMF), the United Nations Economic Commission for Africa (UN-ECA), the United Nations Economic Commission for Latin America and the Caribbean (UN-ECLAC) and the World Trade Organisation (WTO). GIANT was created under the umbrella of the OECD Regional-Global Trade in Value Added (RG-TIVA) initiatives. The goal of GIANT is to converge on a common global benchmark for the input data used by the partner organizations to produce global Inter-Country Supply, Use and Input-Output tables. The common benchmark will ensure comparability and consistency in the compilation of Global Input Output Accounts across different institutions and regions. It will also provide users with consistent messages, irrespective of the specificities of any given Inter-Country Input-Output related product developed by each partner organization. To achieve convergence, the GIANT initiative will explore the feasibility of a common repository of globally benchmarked data and work on a long-term strategy to exchange processed data and associated metadata. Participating organizations will also work together to strengthen the technical capacity of countries in the compilation of national Supply and Use tables and Input-Output tables as well as TiVA analysis through workshops, webinars, trainings, and other capacity-building activities. This presentation presents the current progress of this global initiative and their future work ahead.

An Input-Output model linking Pasinetti's and Prebisch's theories of international trade between developed and underdeveloped countries. The case of Mexico and the US

Topic:
Author: Pablo RUIZ NAPOLES
Co-Authors: CASTAÑEDA LEÓN JAVIER

Abstract
In this work we build an Input-Output model based on Luigi Pasinetti's pure production model and price system, for analyzing trade between the United States and Mexico, in the period 2013-2018. It is viewed as a case of international trade between an advanced and an undeveloped country, as studied by Pasinetti in 1981, associated to Raúl Prebisch's pioneer ideas on this subject in 1959. We base our analysis on Input-Output tables and National Income Account data provided by official Mexican and US agencies.
We find that Pasinetti's trade theories fully apply to the US-Mexico case. In the period 2013-2018: there is a worsening of the terms of trade Mexico to the US; there are not gains from trade in terms of productivity for Mexico and the wage gap remains between the two countries. We show that Prebisch's ideas against unrestricted free trade proved right, despite Mexico being no longer a primary goods exporter as it was in the past.

Assessing the Impacts of Low Emission Electricity Investment Senegal: Economy-wide and Distributional Perspectives

Topic: Regional Analysis
Author: Amarendra SAHOO
Co-Authors: Emanuele FERRARI, Valeria FERREIRA, Victor NECHIFOR

Senegal faces high electricity production costs and aims to reduce reliance on the imported oil and improve electricity access by 2025. With the exploration and production of more natural gas, and the policy of moving away from the traditional oil and coal-based power generation towards gas-to-power generation, Senegal is encouraging higher investment in low emission electricity

infrastructure, including gas-based generation. The study uses a recursive dynamic computable general equilibrium model analyze the economy-wide impacts of the investment in low emission electricity, as well as a top-down microsimulation approach to assess the poverty impacts. The study explores alternative financing options, including domestic private savings, government domestic debt, government financing through foreign aid or bonds and foreign investment.

The results indicate that a 15% increase in investment in low emission electricity leads to a reduction of in high emission electricity generation and a significant increase in low emission electricity generation across the alternative financing options. This results in average reduction in the cost electricity production by 6-14%. An increase in investment by 15% results in overall growth in the real GDP, trade and domestic demand. Although there is only marginal differential GDP impacts across the scenarios, slightly larger growth is observed when higher investment is accompanied by government's financing the investment through increased foreign aid, while it is the lowest when allowing the foreign savings to vary with the increased investment. The pattern of GDP growth is largely driven by the expansion in aggregate domestic demand including household, government and intermediate demand. However, trade balance is relatively lower with the foreign aid financing and higher in case of endogenous foreign savings.

Sectors that are major users of electricity like cash crops, processed food industries, other manufacturing, and services gain in production. Among the exporting industries, most benefit accrues to the food-processing sector followed by chemicals, cash crops, petroleum and other manufacturing industries as these industries become more export competitive. The significant increase in electricity production due to increased investment in low emission electricity and the resulting decline in the cost of electricity puts a pressure on sourcing factors of production in non-electricity activities, leading to increase in the prices of non-electricity sectors.

Households benefit from not only increased electricity consumption, but also increase in their food consumption. The rise in both food and non-food consumption is at its lowest in case of financing through foreign investment. The Increased investment in low emission electricity generation affects household welfare positively. In general, relatively higher welfare gains are registered for the urban households than their rural counterparts, and major gains are experienced from foreign bond financing.

The microsimulation poverty analysis in the study has revealed that investing in low emission electricity infrastructure has the potential to mitigate poverty in Senegal. National poverty declines by approximately 0.30-0.32 percentage points over the simulations, with Poverty reduction appearing to be higher in urban areas compared to rural areas Senegal.

Additionally, there is a substantial reduction in CO2 emission per unit, demonstrating enhanced emission efficiency in the electricity sector, while revealing nuanced impacts on other industries. Looking at the sectoral share of emissions in the baseline for 2025 reveals that sectors such as electricity generation, transportation and mining contribute a large share of total CO2 emissions. Investing in low emission electricity generation has a particularly strong effect on the electricity sector, with a substantial decrease in CO2 emissions per unit of electricity generated across all scenarios, indicating that electricity generation has become considerably CO2 efficient.

In short, the study highlights the potential for overall economic growth, welfare and poverty reduction because of increased investment in low emission electricity. The study also emphasizes the need for consideration of the complex interplay of economic growth, energy demand, and emission efficiencies in shaping CO2 emissions trends. Overall, the study suggests that promoting low emission electricity generation infrastructure has potential to contribute to both economic and social development while also addressing environmental concerns in Senegal.

Systemic Economic Impacts of Variation in International Oil Prices: The Case of Colombia.

Topic:
Author: Guilherme Perobelli SALGUEIRO
Co-Authors: Fernando Salgueiro PEROBELLI

The powerful economic presence of primary commodities as a driving force on exportation is a reality for multiple developing countries. Colômbia, therefore, is included in the group of developing economies. When taking into consideration the international insertion of the country, it is found that there is a late commercial opening that appears latent only from the year 2002. During the first half of the XXI century, in which an enhancement of exportation turned noticeable, it is possible to note a positive change of the Colombian Gross Domestic Product (GPD). (World Bank, 2022). In terms of economic diversification, Colombian exports are based on primary products, in particular, oil. Oil, due to its scarcity and non-renewable nature, combined with its importance as energy input, is a highly desired and traded commodity on the international market. Between 2015 and 2019, oil was the most exported product in the country, representing 38% of the total exporter during the period. In sequence, manufactures represent 21%, and agricultural products are responsible for 19% of Colombian exports.
In order to systematically analyze the variation of world oil prices in the Colombian economy, first, a simulation exercise is carried out using a hypothetical extraction technique applied to the Colombian input-output matrix for 2015. Subsequently, through the optic of Computable General Equilibrium (CGE), an exercise will be carried out through a positive variation of 1% in world prices of the commodity, to verify the implicit elasticity of prices in the country's economy. It is through the variables important to emphasize that such variation will be applied both to export prices, through the variable “f4p” - variation in the prices of demand for exports of a given commodity. As well as in the variation of imported prices - “pf0cif”, given that the oil also inserts itself in Colombia's import list, even if it is to a lesser extent. In this way, the impacts of increases in the international price of oil will be fully measured.
Among the wide range of CGE models available, the ORANI_G was selected, a regional computable general equilibrium model. The model was adapted for different countries, including the present customization for Colombia, developed by Haddad (2016). The regional model of CGE adapted to the country, allows a greater detailing of the national economy, including more precisely the intersectoral and systemic relations, allowing a better assessment of the internal impacts after the proposed shock. It is important to point out that this article is considering the long-term closing. In this scenario, according to Horridge (2006), capital stocks become endogenous and adjust to the model, on the other hand, rates of return are now fixed. Therefore, an open capital market is assumed.
In general terms, after simulating changes in world oil prices, it was possible to evaluate the recurrent impacts of the shock for the Colombian economy. In macroeconomic terms, there is an increase in GDP, mainly linked to the increase in investment and government spending. There is also a positive variation in real wages after the shock, which can also be reflected in the increase in household consumption. However, systemic results for the Colombian economy in the long term also points to a generalized positive variation in basic prices in the economy.
In the long-run scenario, in which commodity prices varied to a greater extent when compared to international prices, there is a loss of the country's external competitiveness. Therefore, it is suggested that economies with a low degree of diversification tend to become more vulnerable in situations of commodity price volatility, as the loss of competitiveness in these products can lead to an increase in the trade deficit. This was also verified in relation to imported products, which expanded their entry into the country after the long-term shock, indicating a potential external dependence on other products as well.

Keywords: Colombia. Computable General Equilibrium. Petroleum.
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Aged-based household carbon footprint in Spain: an inequality and carbon taxation approach

Topic: Regional Analysis
Author: Marina SáNCHEZ
Co-Authors: Guadalupe ARCE, Luis A. LOPEZ, Jorge E. ZAFRILLA

Carbon taxation is a strategy that has been proven to effectively reduce household carbon emissions. This is achieved by internalising the negative environmental impact of production and distribution processes into prices. Furthermore, the application of carbon taxation has been shown to incentivise investment and innovation, leading to further reductions in emissions. However, it is important to consider potential negative effects, such as increased inequality. Understanding how these impacts affect different regions and types of households is crucial for designing effective mitigation policies. The impacts vary depending on the socio-economic characteristics of the households to which they are applied, with certain groups being particularly vulnerable, such as older people - a growing demographic even in developing countries due to improved living conditions. Households consisting of older individuals exhibit specific consumption patterns, with a higher consumption of household goods due to spending more time at home.

Although evidence suggests that environmental taxes can effectively reduce environmental impacts without generating significant economic impacts, their use in Spain is currently limited. Modifications to environmental taxation have been proposed to increase its effectiveness. For example, introducing state-level taxes with broader tax bases and fewer exemptions. This paper aims to analyze the effect of introducing a carbon tax of 100 euros per ton on households classified according to the age of the main breadwinner in the seventeen Spanish regions. It is estimated that the population over 65 years of age will represent 26% of the total population in 2037. To achieve this, information extracted from the Spanish Household Budget Survey's micro-data by region and several household characteristics was combined with the results of applying an environmentally extended input-output model using the multi-regional FIGARO database. The direct emissions generated by the combustion processes of household energy goods in the context of housing and transport are also calculated.

Preliminary results indicate that Spanish households were responsible for emitting 214.429 kilotons of CO2 in 2019. These emissions can be divided into their carbon footprint (150.233 kilotons) and their emissions related to the use of energy for housing and transport (64.197 kilotons). The most polluting households in Spain are those located in Navarra, Madrid, and Islas Baleares, with an average of 13,47, 12,79 and 12,64 tons of CO2 emissions. By contrast, the least polluting households are those located in Extremadura, Ceuta, and Islas Canarias, with an average of 9,51, 9,51 and 9,93 tons of CO2 emissions. When considering age, households where

the main breadwinner is between 18 and 34 years old have the highest intensity of emissions per euro spent. In contrast, households where the main breadwinner is over 65 have the lowest emission instensity. An analysis of Spanish regions reveals that households with lower average expenditure tend to have more polluting consumption patterns. Therefore, households living in these regions are more affected by the tax implementation than those residing in areas with higher average expenditure and less CO2-intensive consumption patterns. These results can assist in proposing local policies and strategies aimed at reducing the intensity of pollution per euro spent, without compromising the economic situation of the most vulnerable households.

Regional Wine Value Chains: trade in value-added flows in Chile

Topic: Regional Analysis
Author: Eduardo Rodrigues SANGUINET
Co-Authors: Elba Lucía FILGUEIRA MUñOZ, Andreass Bastián FISCHER

The wine value chain in Chile has a characteristic regional dimension. Southern areas possess productive capabilities that make the country a recognized exporter of grapes and wine; however, regionally, the distribution of the benefits of the chain is not homogeneous. The objective of this study is to map the structure of value-added flows in the grape and wine chain using an interregional input-output technique. From the demand perspective, forward and backward linkages and interregional flows between grape production and wine production were estimated, allowing the determination of value flows and the potential for upstream and downstream productive development. The results suggest an unequal structure, with a concentration of added value benefits in wine compared to grapes. Southern regions such as O'Higgins, Maule, and Araucanía concentrate the benefits of primary grape production, while the affluent Santiago Metropolitan Region concentrates the benefits of the wine consumer market, which adds considerable value. Finally, value transfers from primary and agricultural regions to prosperous areas that manage to add value to the chain are suggested.

Institutional interrelations in distributive transactions seen through a magnifying glass. A proposal to improve national accounts data on income distribution and redistribution for use in input-output analysis.

Topic: Income distribution policies
Author: Susana SANTOS

Abstract:
"A System of National Accounts" released in 1968 and conceived under the chairmanship of Richard Stone, was the first step to integrate input-output analysis in national accounts. In the first paragraph of its third chapter, with the title "The system as a basis for input-output analysis" of Stone's authorship, according with his autobiography (Stone, 1992), it can be read: "The input-output data contained in the system appear in the rows and columns relating to commodities and industries. In order to explain and illustrate how these data can be used for input-output analysis, a magnifying glass has been applied to the relevant parts of table 2.1 …" (UN, 1968, p. 35; table 2.1 is an illustration of the complete system, in a matrix form, that is, in a social accounting matrix).
Later, in 1981, Richard Stone wrote "… from a formal point of view, input-output analysis could be carried out with other parts of the national accounts or, indeed, with several related parts. In a

... study ..., published in 1977... Graham Pyatt and his associates presented an analysis ... in which they wanted to emphasise the distribution of income ... to set up a framework within which they could analyse actual and potential policies ...” (Stone, 1981, pp. 62-63).
This paper is based on the works of Richard Stone, Graham Pyatt and some of their followers and addresses the measurement of institutional interrelations in distributive transactions, within the conceptual framework of the current version of the “System of National Accounts”.
Without an “A” before, the “System of National Accounts” (SNA, for short) in its current version was released in 2008 and conceived under the responsibility of the Intersecretariat Working Group on National Accounts (ISWGNA, 2009). It covers industry interrelations in transactions in products with the supply and use tables (from which input-output accounts can be conceived). It covers institutional interrelations in financial transactions with the flow-of-funds tables or matrices, but it does not cover distributive transactions. This means that, in the study of the economic system, while the parts relating to the production and financial processes can be supported by (more or less, powerful) magnifying glasses provided by the national accounts, the part relating to the distribution process has no support at all.
Thus, for the six groups of institutional sectors identified by the SNA, starting from the published totals of the current and capital accounts, organized in the defined sequence, the nine categories of distributive transactions (disaggregated at the second level) are analysed individually and the possibilities of filling in the so called from-whom-to-whom matrices are explored. Since the resources of some are the uses of others, it will be shown how information about the origin of the resources (from-whom), or the destination of the uses (to-whom) can complete the filling of these matrices.
Therefore, albeit for a reduced magnification level, this proposal can be seen as a starting point for something more amplified, capable of being used within the scope of input-output analysis. Its implementation would enable a better treatment of the networks of transactions between institutional sectors underlying the distribution process, which would certainly be reflected in the study of the distribution and redistribution of income, in any possible aspect, namely, inequality, poverty, wealth, corruption, etc.

Key words: National Accounts; Social Accounting Matrices; Input-Output Analysis
JEL Codes: E01; E16; D57

Wage gender disparity by activity and skills: empirical evidence in Italy

Topic: Employment Policies
Author: Francesca SEVERINI
Co-Authors: Rosita PRETAROLI, Claudio SOCCI, Ludovica ALMONTI

Economic inequality by gender covers a broad spectrum of interpretative and quantitative dimensions. Gender gaps affect the labour market, participation in decision-making processes, and women's educational levels (Bettio and Verashchagina, 2008). Hence, the transition towards gender equality and women empowerment represents one of the main policy objectives pursued and encouraged by international institutions all over the world. Among the priority areas identified by the EU Gender Equality Strategy, the reduction of the gender pay gap and the increase in female labour participation play a key role, especially in terms of their potential contribution to a country's economic growth. Usually, the analysis of the gender pay gap refers to an aggregate indicator reflecting the average gap between men and women in terms of remuneration at work (Bishu & Alkadry, 2017). But, since the factors affecting the gender wage gap are linked to different levels of education, skills and type of employment, as well as the

characteristics of the production sector to which it refers (Gannon et al. 2007), the existing literature does not express a unanimous position on the technique for estimating the wage gap (Kunze, 2008) but at the same time, it confirms that policymakers need to intervene in a differentiated and precise manner, with selected policy tools able to deal effectively with the peculiarities found (Severini et al. 2019).

Although in European economies the gender gap has narrowed in recent decades, payment inequalities and labour segmentation are still high in most countries (Addabbo et al, 2011) and this condition aggravated after the pandemic crisis especially for high and low-educated workers. Indeed, only when the educational attainment is high for both males and females, the gender wage gap tends to decrease, and men and women end up doing more similar jobs and occupations. On the contrary, low-educated and less experienced workers show a larger gender wage gap (Addabbo et al. 2020).

This demonstrates the wide-ranging complexity of economic gender disparities which necessarily involves numerous economic policy instruments. From our point of view, the most critical aspect is the aggregate approach to the issue of the gender gap, as it is directly related to the diversity of production processes, the different types of labour markets and the skills possessed by workers. In this perspective, the article aims at contributing to the current debate in the literature by emphasizing the crucial role that a disaggregated and general equilibrium approach can play to support the policy maker, especially in the formulation of policies for female employment integration and gender pay gap reduction in specific sectors or for occupational profiles. The focus is on the Italian economy since the dimension of the gender gap is the one in which Italy lags furthest behind the other dimensions such as social, education, health and politics (Profeta, 2020). In a dynamic perspective, it is important to ascertain in advance, what are the potential consequences of policies aimed at expanding the female labour participation, that is considered one of the most relevant issues, in a system characterised by a pre-determined structure of production and labour market. Indeed, the effectiveness of policies could be threatened by an economic/productive structure that is unable to overcome inequalities (in employability or wages) despite the change in labour supply. Here, we decided to deeply analyse what type of effect a change in the male and female workforce can have on the reduction of the gender pay gap, across different activities. In other words, the research aims to investigate the connection and the response of female and male wages for different levels of skills when the labour supply changes as a consequence of an exogenous change of conditions. The purpose is evaluating whether a policy or a supply side shock aimed at stimulating the supply of labour (especially female labour supply) is enough or necessitate a further intervention by the policy maker to reduce the gender inequalities.

To do this, we construct a Dynamic Computable General Equilibrium (DyCGE) model based on the Social Accounting Matrix (SAM) integrated with gender specifications for the Italian economy. In particular, the compensation of employees by activity is further disaggregated by skills (in terms of digital competencies) and gender. This provides all the data necessary to calibrate the DyCGE model where the wage setting for the labour market takes into consideration wages for men and women also in terms of skills. Then, a set of scenarios assuming the change in the male and female labour supply offer the potential outcomes in terms of gender wage gap of policy measures aimed at stimulating the back-to-work of discouraged man and women with a significant contribution to policy planning.

Can India Achieve Manufacturing-led Growth? Exploring Policy Strategies Using CGE Modelling Analysis

Topic:
Author: Akhilesh Kumar SHARMA

Manufacturing has played a significant role in the development process. The growth of the richer countries in the world had been led by the manufacturing sector. However, the sector is shrinking in almost every country in the world indicating premature deindustrialization in the developing countries. The Indian economy has shown a non-traditional growth trajectory in terms of industrialization. Its share of manufacturing in gross domestic product (GDP) has declined to around 16 percent. Given the labour-abundant economy, India can harness the potential of its industrial capabilities by increasing its share of the manufacturing sector in GDP and transform into a developed economy. The present study aims to explore policy strategies for achieving manufacturing-led development in India using a computable general equilibrium modeling framework. Our findings indicate that a sustained comprehensive policy intervention through investment and productivity enhancement in the manufacturing sector as well as production incentives to firms and demand/income incentives to households along with policies for domestic firm protection has the potential to achieve inclusive manufacturing-led growth in India in 6 years. It has a significant positive impact on GDP, income, employment and trade. Its distributive income effect is more in favour of rural areas and the poor. Consequently, manufacturing-led growth has potential to promote inclusive development. Further, policies merely focusing on labour-intensive sectors, protection of domestic industries, or tax incentives may not have desirable results and can be counterproductive also. Therefore, this study suggests that there is a need to adopt a long-term comprehensive industrial policy framework to achieve manufacturing-led growth and SDGs and transform the country into a developed economy. Being first study focusing on exploring alternative policies to promote manufacturing-led growth in India using general equilibrium framework, this study significantly contributes to the policy discourse and existing knowledge.

Environmental Consequences in the Lifecycle Change of Container Vessels

Topic: Sustainable Production and Consumption Policies
Author: Taiga SHIMOTSUURA

In response to global efforts to reduce CO2 emissions, the International Maritime Organization revised its greenhouse gas reduction target in 2023. The new goal aims for at least a 70% reduction by 2040 compared to 2008 levels. This target is so ambitious that the current energy efficiency regulations in force have inadequate reduction potential. Consequently, zero-emission vessels using alternative fuels are gaining attention as key contributors to achieving this reduction target.

Previous studies suggested the introduction of zero-emission vessels as soon as possible. However, literature on lifecycle assessment (LCA) has confirmed that a longer lifetime of durable goods contributes to reducing lifecycle CO2 (LCCO2) emissions. The extended lifetime involves an environmental trade-off, resulting in increased CO2 emissions during the use phase but decreased emissions in the manufacturing phase.

To ensure sustainable development in international shipping, the trade-off resulting from the

introduction of zero-emission vessels must be analyzed. Therefore, this study addresses an important research question: whether the longer lifetime of vessels contributes to reducing LCCO2. The study aims to answer this question and propose decarbonization policies concerning lifetime changes.

Although estimating the LCCO2 of vessels during their lifetime is necessary, the average lifetime of vessels was not statistically specified. The novelties of this study are twofold. First, it identifies the lifetime distribution of container ships, contributing to advancing LCA research on ships that typically assumes an average lifetime as a fixed value. Moreover, this identification model is applicable to other ship types as well. Second, the study empirically investigates the impact of lifetime extension of ships on LCCO2. This demonstration supports decision-makers in developing decarbonization policies concerning the lifetime of ships.

Specifically, the study initially estimates the average lifetime of conventional vessels using maximum likelihood methods and Akaike's Information Criterion. Additionally, by varying the lifetime from -10 years to +10 years, LCCO2 emissions in 2040 are estimated using a stock-flow model. Based on the results of LCCO2 estimation, the impact of changing the duration of vessel use on LCCO2 is analyzed. The LCCO2 includes CO2 emissions from both the manufacturing and use phases. Manufacturing emissions, consisting of direct and indirect emissions, are estimated through environmentally-extended input-output analysis. It should be noted that this study focuses on container vessels because container shipping emits the largest amount of CO2 emissions from international shipping.

This study utilized the following data: Sea-web data from IHS Markit includes information on the year each ship was built and retired. Consequently, this study uses Sea-web data to apply maximum likelihood methods and the stock-flow model for estimating the average lifetime of container vessels and the total stock of vessels for each year, respectively. Additionally, the data of embodied CO2 emission intensity of container ships are obtained from 'Embodied Energy and Emission Intensity Data for Japan Using Input-Output Tables (3EID)'. The producer's price data for an average conventional container ship is acquired from 'Survey on Shipbuilding and Engineering' in Japan.

The results indicate that the average lifetime of conventional container vessels is 23.97 years. This result verifies that the lifetime assumptions in existing studies (ranging from 20 to 26 years) are mostly reasonable. Based on the results of LCCO2 calculation with variations in the lifetime from -10 years to +10 years, this study reveals that shortening the lifetime can effectively reduce LCCO2. One contributing factor to this result is that use-phase emissions (213.6 Mt-CO2) are much higher than manufacturing-phase emissions (9.3 Mt-CO2), as observed by comparing the emissions from use and manufacturing phases in 2008.

Furthermore, we set the natural replacement scenario under the specified lifetime distribution and the governmental intervention scenario where the government forces shipping companies to replace older vessels aged 24 years and more with new container vessels. A comparison between the LCCO2 emissions under the natural replacement scenario and the governmental intervention scenario shows that the governmental intervention can enhance the CO2 reduction effect of energy efficiency regulations by up to 15%. Furthermore, the environmental benefits through governmental intervention become more significant as the energy efficiency regulations get stricter.

In conclusion, this study confirms that accelerating the replacement cycle (i.e., setting the maximum value of operational years) and implementing stronger energy efficiency regulations

would have a synergistic effect, highlighting the importance of lifetime policies.

CO2 Mitigation Potentials through Sub-global Policies in International Shipping Sector

Topic: YSI and Development Programme IV (Discussant: R. Duarte and S. Miroudot)
Author: Tomomi SHODA
Co-Authors: Shigemi KAGAWA, Keitaro MAENO, Taiga SHIMOTSUURA

CO2 emissions from international shipping represented approximately 2% of global energy-related CO2 emissions in 2018. Shipping emissions are projected to increase from about 90% of 2008 emissions in 2018 to 90-130% of 2008 emissions by 2050 due to a continuous increase of global maritime trade. Given that shipping is the most energy-efficient means of transporting cargo in terms of energy use per tonne-kilometre, it is irreplaceable in the international trade process. Consequently, there is an urgent need to reduce CO2 emissions from international shipping.

Current mitigation policies for the international shipping sector are primarily global mitigation policies. However, it has been pointed out that the effectiveness of global mitigation policies is limited recently. Supplementary approaches such as sub-global policies are necessary. Particularly, national policy interventions, including a) the amount of freight imported and exported, and b) the source and destination of freight imported and exported, have significant potential to influence shipping system.

To quantitively examine the environmental impact of a) amount of freight imported and exported, this study utilizes microdata for movements of container ships and focuses on the environmental efficiency of international shipping network, suggesting possible sub-global mitigation policies to port authorities. To examine the environmental impact of b) source and destination of freight imported and exported, this study quantifies CO2 emissions induced by Japan’s sea container cargo commodity import. Through the scenario where Japan changes its import destination from China to the USA, by assessing both the environmental efficiency of container shipping and direct and indirect carbon intensity of the manufacturing industry in each country through global supply chain, this study provides the Japanese government with a comprehensive perspective for restructuring the global supply chain (GSC).

We first estimated the combined annual CO2 emissions from container ships owned by top 10 container ship operator companies, accounting for 84% of the world fleet of container ships. The combined annual CO2 emissions from container ships owned by top 10 container ship operator companies through world’s ports were 161.8 Mt in 2018 and 9.7 Mt through Japan’s ports. Furthermore, we identified environmentally important ports based on the responsibility for offshore carbon emissions allocated to ports. If container ship operators with environmental efficiencies worse than the average environmental efficiencies of the top 10 companies transported freight with the average environmental efficiency, the potential for CO2 reduction was estimated at 4.3 Mt-CO2. Therefore, we suggest that, for port authorities, it is important to leverage ports’ role in the international shipping network to impose restrictions on the environmental efficiencies of container ships to/from ports.

In addition, we quantified the CO2 emissions reduction potential of Japan’s sea container cargo commodity imports by considering the environmental efficiencies (i.e., CO2 emissions from international shipping per import value in t-CO2/million USD) of imports from China and the USA

to Japan. If Japan changes its trading partner for commodities from China to the USA, there would be an increase of 120 t-CO2 emissions per million USD in the sea transport process.

Next, we utilized the embodied CO2 emissions intensities of sectors and countries from the World Input-Output (WIOD) database and quantified the CO2 emissions reduction potential of substituting a specific product made in the U.S.A for one made in China. The 'perfect' substitution of machinery products from China by products from the USA could reduce CO2 emissions by 909 tons per million USD in the production process, far exceeding the increase in CO2 emissions during the sea transport process. However, for crop and animal products, CO2 emissions reduction in the production process is only 88 tons per million USD, which cannot offset the increase in CO2 emissions in the sea transport process. The results indicate that the decision to change trading partners depends on both the environmental efficiencies of international shipping from the import destination and the environmental efficiencies in the production process of the specific product.

In conclusion, sub-global policies in international shipping sector have significant potentials to mitigate CO2 emissions from international shipping, and the cooperation between stakeholders, such as the IMO, state governments and port authorities, is essential. Additionally, for national governments, both the carbon footprint through GSC at the production process and the environmental efficiencies of international shipping should be considered when deciding import and export destinations.

Quantifying the Digital Economy using an Input Output Approach

Topic:
Author: Sanjana SHUKLA

Technological advancements have fundamentally changed how the world produces and consumes. With improving connectivity and lower device costs, applications of digital technologies are becoming increasingly pervasive. India has been at the forefront of this digital revolution. Quantifying and understanding the role of the digital economy in driving economic growth, employment and sustainable development is essential for both policymakers and the private sector to adopt appropriate strategies and align resources.
Capturing the size of the digital economy, and the linkages that comprise it, is therefore more important than ever before. Doing this requires a robust measurement system that enables continued estimation and monitoring. Past estimates have ranged from 5.4-5.6 % of GVA in 2015 to 8.5% of GVA in 2019 (Gajbhiye et al, 2022; ADB, 2021). The Ministry of Information Technology has estimated that India's digital economy has the potential of an economic value of $1 trillion by 2025, supporting over 55 million workers. This paper provides an updated, more comprehensive, and more accurate estimate of India's digital economy using input-output analysis. It uses a combination of various data sources to validate and refine the estimate.
It builds upon the Asian Development Bank's measurement framework to capture the digital economy, which estimates value added from the core digital economy , as well as forward linkages and backward linkages. ADB's methodology uses national input-output tables to create a satellite account of the digital economy. This paper first transforms India's latest national supply use tables (SUT) of 2019-20 into an input-output table (IOT), and then adopts ADB's methodology.

'Computer related services' and 'manufacturing or computer and peripheral equipment' are industries that can be entirely classified as part of the 'core' digital economy, defined as hardware, software publishing, web publishing, telecommunications services and specialized &

support services. Given the level of aggregation of the SUT, and subsequent IOT, some industry categories comprise activities that would fall within the core digital economy as well as some that would not. These partially digital industries, 'Communication' and 'Manufacture of electronic components, consumer electronics, magnetic and optical media', are partitioned into 'digital' and 'non-digital' portions using other data sources including the National Accounts Statistics and Annual Survey of Industries. Once industries of the input-output table are partitioned and classified as digital or non-digital, the Leontief coefficients and matrices are extracted to estimate the forward and backward linkages.
In addition to quantifying the digital economy, this analysis helps understand which sectors are driving growth in the core digital sectors. Simple output and value-added multipliers are also calculated, in order to distinguish the direct and induced effects.
The paper also identifies limitations of the input-output approach to capture the value-added from the digital economy in its entirety - particularly productivity gains attributable to digital inputs that are not reflected in their prices. It also points out challenges related to estimating contribution of emerging technologies, which are and will continue to remain important aspects of the rapidly evolving digital economy. The scarcity of appropriate and granular data poses a potential trade-off between accuracy and completeness in capturing the digital economy. The input-output approach provides greater accuracy and understanding of sectoral linkages at the cost of completeness. Relying on IO tables also enables comparison over time and across countries due to its standardization and consistency. The reliability of this method, however, depends on the reliability of the national SUTs and/or IOTs. Having a framework that is robust yet adaptive to the changing nature of the digital economy, supported by appropriate and regular data collection is increasingly important as the digital transformation encompasses more aspects of the economy.

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Climate Challenges in Agriculture: The effects of the phenomenon El Niño in the Brazil Central Region

Topic: Regional Analysis
Author: Cláudio Eurico Seibert Fernandes da SILVA
Co-Authors: Fernando Salgueiro PEROBELLI

This study aims to assess the inter-regional economic impacts of El Niño on the 2023/2024 agricultural season in the central region of Brazil. El Niño, a recurrent natural phenomenon, is characterized by abnormal and persistent warming of the Pacific Ocean waters, extending from the Equator to the coast of South America. This elevation, persisting for at least six months without a defined timeframe, involves abnormal warming of at least 0.5ºC above the average, resulting in climatic patterns, including irregular rainfall and elevated temperatures. Nevertheless, the impact of greenhouse gases' increased emissions, responsible for climate change, has heightened the frequency and intensity of climatic events, such as El Niño. These

climate changes bear significant consequences for agriculture, given that the sector is among the most vulnerable to alterations in precipitation patterns and the intensification of heat waves, impacting both planting schedules and crop development. Brazil stands out globally as one of the largest grain producers, with the Central-West region comprising the states of Mato Grosso, Mato Grosso do Sul, and Goiás, which are significant producers of soybeans, corn, and cotton. Nevertheless, during the 2023/2024 season, climatic instability and uneven rainfall distribution in the central region resulted in significant planting delays and negative impacts on the productive potential of crops. These adverse climatic events, including the El Niño, have generated uncertainties and hindered decision-making by agricultural producers. According to the CONAB (National Supply Company) crop report, the projection indicates a 4.5% loss in grain productivity (kg/ha) in Brazil for the 2023/2024 season, with the Central-West region being the most affected, experiencing a loss of 10.3%. Nevertheless, these impacts are not evenly distributed across the country, underscoring the necessity to analyze these inter-regional effects on the local economy. For this, we will apply the Agro-CO Computable General Equilibrium Model. The model has been constructed based on two Input-Output estimation matrices for Brazilian Agribusiness. The first matrix disaggregates agribusiness segments in the national matrix, explicitly representing the soybean, corn, and cotton sectors. The second matrix employing the IIOAS method estimates an inter-regional matrix for the 53 immediate regions of the Brazilian Central-West. The Agro-CO inter-regional computable general equilibrium model is static, bottom-up, and of the Johansen type, constructed based on the B-MARIA (Brazilian Multisectoral and Regional/Interregional Analysis Model). Thus, this study aims to contribute to the literature through an analysis capable of capturing regional disparities, supporting the formulation of public policies that aim to implement adaptive and mitigating measures to address the challenges posed by climate change, such as those faced during the El Niño phenomenon, whose frequency and intensity would expect to increase over the years.

Unraveling the Trade Potential of BRIC: A Comprehensive Analysis of Global Value Chains and Intra-BRIC Trade in Value-Added

Topic: Input-Output Theory and Methodology
Author: José Firmino de SOUSA FILHO
Co-Authors: Rodrigo Barbosa de CERQUEIRA, Larissa Lopes LIMA, Luiz Carlos de Santana RIBEIRO

(1) Research Question:
The research question revolves around understanding the characteristics and dynamics of the world input-output network (WION) and its implications for global trade, mainly focusing on the participation of emerging economies such as the BRIC countries (Brazil, Russia, India, and China). Additionally, the research aims to analyze the evolution of trade patterns, value-added trade, and trade intensity among these countries within global economic integration.
(2) Method Used:
The method employed in the research involves analyzing the WION using the available World Input-Output Database (WIOD). The analysis includes examining global network properties, subgraph structures, and dynamics of the WION using network analysis techniques such as community detection. Additionally, traditional input-output analysis methods like the Laumas and eigenvector methods are compared with network-based measures like PageRank centrality and community coreness to identify key industries.
(3) Data Used:
The primary data source used is the World Input-Output Database (WIOD), which provides comprehensive input-output tables covering various countries and industries. Other data sources, such as trade statistics, GDP data, and industry-specific data, may complement the analysis.

(4) Novelty of the Research:
The novelty of the research lies in its comprehensive analysis of the WION and its implications for global trade, with a specific focus on the participation of emerging economies like the BRIC countries. The research provides new insights into global trade patterns' structural characteristics, dynamics, and evolution by employing network analysis techniques and comparing traditional input-output analysis methods. Additionally, the research contributes to understanding the role of value-added trade, trade intensity, and technological specialization in shaping trade relations among countries within the WION framework.

Hydro-economic equilibrium and territorial scope of water policy in the local systems of Tuscany, Italy.

Topic: Sustainable Production and Consumption Policies
Author: Gino STURLA
Co-Authors: Benedetto ROCCHI

The Tuscany region (Italy) does not present major issues in terms of water stress when analyzed at a regional scale (Venturi, 2014; Rocchi and Sturla, 2021). Sturla and Rocchi (2022a) demonstrated that when the regional economy is faced with 100 hydrological years, water exploitation indicators never exceed scarcity thresholds.

However, this regional perspective conceals significant spatial heterogeneities. Greater availability of surface and groundwater is found in the northern and northeastern areas. Water demand primarily concentrates in the central part of the region (74% of GDP).

To address this spatial variability, Sturla and Rocchi (2022b) studied the hydro-economic equilibrium (HEE) at the local systems (LLS) level using an interregional input-output hydroeconomic model. The study considers 49 LLS and estimates the extended water exploitation indicator (EWEI) for 100 years, comparing it with scarcity thresholds (STg).

SLLs are defined as aggregates of municipalities based on economic, not hydrological criteria. For LLS that could face water scarcity issues, sustainable resource management policies are required, which could be formulated at the local, watershed, river basin, or regional level.

In this context, an interesting research question arises: What are the characteristics of hydroeconomic equilibrium when considering hydrological spatial scales, and how does this determine the territorial scope of water policies in each LLS?

Therefore, this study aims to conduct an integrated economic-ecological analysis at the basin and sub-basin level to evaluate whether HEE is achieved in the analyzed spatial units. The objective is to determine the most suitable territorial scope for designing sustainable water management policies.

The analysis considers 4 basins and 10 sub-basins, assigning the 49 SLLs of the region to them, taking into account their area and existing hydraulic interconnections (AIT, 2023; ADAS, 2021).

To evaluate HEE, two interregional input-output matrices (56 economic sectors) are constructed based on the aggregation of the matrix at the SLL scale (IRPET, 2021). Sectoral coefficients for water use and restitution and those associated with water dilution requirements are calculated.

Hydrological component matrices are developed for basins and sub-basins, considering precipitation, evapotranspiration, surface runoff, and groundwater recharge. These matrices contain simulations for 100 hydrological years based on a spatial stochastic hydrological model (D'Oria et al., 2019; Pranzine et al., 2020).

Following the methodology proposed by Sturla and Rocchi (2023), an interregional hydroeconomic model is constructed to estimate EWEI and STg for each unit of analysis and hydrological year.

This study defines sustainability criteria as the situation where the exploitation indicator does not exceed the threshold by more than 15 years (out of 100 years). That is, a spatial unit is in HEE if this condition is met.

The territorial scope of water policies is determined based on the spatial unit where water availability management required by an LLS for sustainable resource use must be addressed. Thus, four types of territorial scope are defined:

• Local Scope: if the SLL is in HEE
• Sub-basin Scope: If the SLL is not in HEE, but the sub-basin is
• Basin Scope: If neither the SLL nor the sub-basin is in HEE, but the basin is
• Regional Scope: If neither the SLL, sub-basin, nor basin is in HEE

Results indicate that 2 out of 10 sub-basins do not meet HEE, while all basins do. When considering the climate change availability scenario, sub-basins increase to 3, and basins without HEE are 2 out of a total of 4.

Results indicate that 33 LLS require Local Scope management, 10 require Sub-basin Scope, and 6 require Basin Scope. When considering climate change, 30 LLS require Local Scope, 8 require Sub-basin Scope, 4 require Basin Scope, and 7 LLS require Regional Scope.

The results show significant sub-regional heterogeneity not only concerning the balance between water demand and supply at different spatial scales but also regarding the required territorial scope for policies. This heterogeneity increases when considering climate change.

This study represents an advancement in the application of regional science methodologies for studying sustainability in local systems. Key highlights include:

• Pioneering use of sub-regional input-output matrices to study HEE at both hydrological and economic spatial scales, considering water requirements by economic sectors.
• Integration of the spatial dimension of water policies in a novel manner. The developed model allows flexible disaggregation and aggregation of the economic and hydrological systems.
• The proposed model enables simulation of water availability scenarios for climate change and evaluation of the effect of increased final demand on hydroeconomic equilibrium and policy scope.

Digital Economy and the Increasing Labor Compensation Share in China: Based on Non-competitive Digital Economic Input-output Table

Topic: Price and Income Policies
Author: Qi SU
Co-Authors: Xu JIAN, Jialu SUN, Chuan LI

The Labor Compensation Share (LS) as a crucial indicator measuring a household's share in the primary income allocation has an important influence on both the composition of final demand and household welfare. As a sequence, LS has attracted wide attention from policy-makers and researchers in China. With the development of the digital economy, the factors related to digitalization have become inevitable to participate in the primary income allocation. Whether or not the digitizing economy would reduce LS by replacement effect is worthy of study. This paper distinguishes the digital economy and traditional economy components related to input-output coefficients, composition of final demand matrix, and employee compensation coefficients vector under the digital economy input-output framework. It proposes a structural decomposition analysis to explore the impact of the development of the digital economy on the evolution of overall LS in China. An empirical analysis has been done based on the compiled non-competitive digital economy input-output tables of China for 2012, 2017, and 2020. The results show: (1) Holding all other factors constant, the changes in factors related to the digital economy decreased overall LS by 17.72% between 2012 and 2017; and increased overall LS by 11.69% between 2017 and 2020; (2) Among all factors related to digital economy, the most important driving force of changing LS is production technology changes related to digital economy rather than changes in employee compensation coefficient of digital economy sectors; (3) There exists a small number of key sectors and important coefficients who could determine the contributions of the changes in driving factors on LS changes. This study discovers how the development of the digital economy affects overall Labor Compensation Share in China from the perspectives of comparative static analysis and multi-sector dependency relationships and could provide some implications for the formulation of Income Distribution policies.

Energy in input-output analysis: a historical perspective

Topic: Special Session: Integration of energy systems models and economic models: advances and applications
Author: Sangwon SUH

This abstract is submitted for the special session, "Integration of energy systems models and economic models: advances and applications" organized by Professor Matteo V. Rocco.

In this presentation, the history of energy input-output literature is reviewed. The works by late Bob Ayres will also be introduced for his contribution that recognized the linkage between natural resources and the economy using input-output structure in the 1960s. Among the subjects included are: the works of Walter Izard who recognized the linkages between nature and the economy and the field of ecological network modeling in the 70s and 80s, which used energy as the currency of ecological networks using the Ghoshian input-output modeling. I will also touch upon the similarities and relationships between the Ghoshian IO model and the absorbing Markov-chain model. I will also touch up on the recent works by Koopmans et al., where the Ghoshian model is revived but in a different spin. I will also talk about Cutler Cleveland and Bob Costanza's works in the 80s published on Science that culminated the golden era of energy

input-output modeling in the mainstream science. I will finish with my understanding of the state-of-the-affairs in energy input-output analysis and its prospects.

Research on the Factors Influencing the Accuracy of Heterogeneous Input-Output Models

Topic: Input-Output Theory and Methodology
Author: Jialu SUN
Co-Authors: Xu JIAN, Zhijian JIANG, Chuan LI, Qi SU

The input-output model, as a general equilibrium model, plays an irreplaceable role in simulating economic shocks, evaluating economic policies, and interpreting causal relationships in macroeconomic changes by depicting the structural impacts of economic shocks through clear inter-sectoral production networks. However, traditional input-output models only differentiate industries or products, while the assumption of intra-sectoral homogeneity obscures the reality where different types of enterprises within the same sector employ diversified production technologies, possess different consumption structures, and target different markets. Scholars have innovated and improved heterogeneous input-output models to capture intra-sectoral technological differences, thereby enhancing the model's ability to delve into the internal dynamics of economic sectors from a more micro perspective, analyzing variations in production technologies, and inter-industry linkages within the same sector.
Nevertheless, existing research on heterogeneous input-output models is limited to empirical applications, lacking theoretical analyses on the accuracy and reliability of these models. Compared to traditional input-output models, the absence of uncertainty analysis in heterogeneous input-output models has a more severe impact on the scientific rigor of research findings. This is because the increased dimensions of input-output models entail a surge in the demand for inter-sectoral flow data, which existing statistical data struggle to accurately account for. The construction of heterogeneous input-output models thus relies on proportion assumptions and mathematical optimization methods to fill in missing data. The numerous assumptions made during model construction lead to a hidden paradox: while increasing model dimensions enriches the information depicted by the model and enhances its ability to explain differentiated production technologies of enterprises in reality, the massive inter-sectoral flow data required for constructing heterogeneous models mainly come from estimations, inevitably introducing significant errors compared to actual inter-sectoral flows, severely affecting the reliability of heterogeneous input-output models.
Therefore, there is a need for in-depth and systematic research on the accuracy of heterogeneous input-output models, to clarify the factors influencing the accuracy of heterogeneous input-output models. Based on this studies, methods to improve the accuracy of heterogeneous input-output models could be proposed.
This paper is a further study on the measurement methods and case analysis of the accuracy of heterogeneous input-output models presented at last year's Alghero Conference. It improves the methods for measuring the accuracy of heterogeneous input-output models based on Monte Carlo simulation and TRAS, effectively addressing the challenge of the lack of a comparative basis for studying the accuracy of heterogeneous input-output models. Building on this, using the Input-Output Framework for Foreign and Domestic Firms (ICIO-DF) released by OECD as research materials, this paper explores the forms of errors in intermediate flow matrices, the scale of economies or economic sectors, the granularity of sectoral divisions, the relevant characteristics and structures of input-output matrices, and the impact of key sectors or elements of input-output matrices on the accuracy of heterogeneous input-output models.
The results show that: (1) The uncertainty of heterogeneous input-output models increases with

the growth of errors in intermediate flow matrices, but the magnitude of error expansion exhibits a gradually convergent feature. This characteristic is guaranteed by the specific structure of heterogeneous input-output models and the precision of larger elements in input-output matrices. (2) There is a positive relationship between the scale of economies or sectors and accuracy. Larger economies or sectors are more accurate in heterogeneous input-output models. (3) The finer the sectoral divisions, the more accurate the overall results of the model. Using as detailed data as possible in model construction helps improve accuracy, even if these data are contradictory. (4) The higher the proportion of non-zero elements in the intermediate flow matrix, the more accurate the heterogeneous input-output model. The rich inter-sectoral input relationships enhance the complexity of the model, increase the constraints of the input-output matrix, and thus improve the overall accuracy of the model.
Heterogeneous input-output models have been widely applied in trade value-added and environmental economics. Research on the accuracy of heterogeneous input-output models can provide information on quantifying the uncertainty of research conclusions, helping decision-makers understand the assumptions and limitations behind the data, and enabling them to make informed decisions under full information.

An integrated household expenditure and input-output model

Topic: Input-Output Theory and Methodology
Author: Umed TEMURSHO

Taylor (2013) developed an empirical approach to the analysis of household consumption behavior, which has been further extended and applied in a series of subsequent papers by the same author. It turns out that the so-called “intra-budget” coefficients, which quantify the direct relationships between an exhaustive set of expenditure categories and are econometrically derived from consumer expenditure surveys, displayed remarkable stability quarter-to-quarter when using the BLS quarterly Consumer Expenditure Surveys from 1996 through 2005. Taylor’s consumption expenditure model is attractive for several other reasons, including its purely empirical basis and consistency with a variety of preference structures, representation of the conjunctive effects of household tastes and preferences together with those of prices and income, its straightforward use for calculating own- and cross-price elasticities, and its applicability for the distributional analysis of various policies such as inflation, carbon taxes, and the Covid-19 pandemic.

In this paper, we connect Taylor’s consumption expenditure model to Leontief’s quantity and price input-output (IO) models. By linking consumption reactions and the interindustry models, the economy-wide (production and consumption) spillover and feedback effects between the two types of models are properly accounted for. Thus, this integrated macro-micro framework allows incorporating the circular consumption-production-income roundabout impacts, drawing on the empirical regularities of interconnectedness of household consumption expenditures obtained from household budget surveys. We study in depth some of the main theoretical properties of this new integrated macro-micro IO model. As an empirical application, we study the distributional impacts of recent increases in energy prices in the EU27 economies. Additionally, as a byproduct of this work, we provide researchers with a comprehensive set of price and income elasticities for 27 EU countries and 5 household income groups.

Footprint analysis and the regressivity of emission taxes

Topic:
Author: Thijs TEN RAA

We show that the incidence of emission taxes on consumer income classes is proportional to the footprints of their respective consumption bundles. The dimensions of the footprints are industry by product, but the literature employs industry-by-industry input-output coefficients. We rectify footprint analysis by returning to the underlying national accounts, the use and make tables. Bringing in budget shares data of the different income classes (Engel curves), we show that the carbon dioxide footprint per euro expenditure decreases with income. Our result renders an emission tax regressive and thus implies a tradeoff between environmental and income policies.

Extended Supply and Use Tables of Mexico. Base Year 2018

Topic: Special Session: Extended SUTs and IOTs - experiences and techniques of national statistical institutes and international organizations
Author: Jose TERAN-VARGAS

This research has the purpose to solve the problem of extending the Supply and Use table (SUT) for Mexico for the base year 2018 given the information available and constraints and also improving the Extende SUT (ESUT) compiled for the year 2013. The purpose is also to show how can a National statistics Institute explore and process its sources of information to deliver a ESUT.

The reasearch shows how the Terms of Reference published by OECD are flexible and this gives rise to proposals for extensions. In the case of Mexico, given the sources of information there can be some propositions of disagregation, based on the establishment as the economic unit made posible in a five years basis through the information from the Economic Census 2018 linked to foreign trade records and other administrative Records and surveys. These extensions and the sources of information collected by the Institute allow the extension for the focus on property, size, formality and informality, and exports oriented production. There are also additional extensions to be published later in 2024, such as the extensions of the components of the Value Added of the Exporter Focus and the Table of Use of the Exporter Focus by domestic and imported origin.

Trade Policy as Climate Policy: Payoffs and Tradeoffs

Topic:
Author: Karen THIERFELDER
Co-Authors: Delfin Sia GO

Reducing carbon emissions is a global public good: every country has an incentive not to reduce its own emissions and still benefit from the actions of compliant countries. We explore how import tariffs can solve this free-rider problem. We use a multi-region, multi-sector computable general equilibrium (CGE) model in which some countries adopt a carbon tax and compete with non-compliant countries in global markets. Data are from GTAP 10; there is a social accounting matrix (SAM) for each region in the model. Regions are linked via trade flows. We use GTAP satellite data sets for carbon dioxide (CO2) emissions. We include information on CO2 emitted per unit of fossil fuel used in each production activity and household by region. Our model includes

production and trade linkages among integrated regions in the global economy: Europe, NAFTA, and East and Southeast Asia, a novel feature of the CGE model. We use nested import demand functions: aggregate imports are substitutes for the domestic variety; aggregate imports are a constant elasticity of substitution (CES) aggregate over imports by integrated region. Import substitution among countries in an integrated region (e.g. US, Mexico, and Canada in the NAFTA region) is low to reflect the integration of production and specialization of imported intermediate inputs in production.

First, we consider the European Union (EU)'s carbon border adjustment mechanism (CBAM) in which non-compliant countries face import tariffs in selected sectors based on the carbon emitted in production. Tariffs are based on the CO2 emitted in producing goods for export. We consider different methods to calculate the emissions from production. First, we consider only the direct effects which account for the emission of CO2 when producers burn fossil fuels in production. Then we consider the direct and indirect CO2 emissions which account for the emissions used in intermediate inputs. Finally, we consider direct and one round of intermediate input use to compute emissions. In this case, we include the emissions from use of electricity as an intermediate input.
We find that CBAM helps EU producers because it "levels the playing field," CBAM does not reduce global emissions because exporting countries can diversify their trade to non-EU countries.
Consistent with other studies, we also find that direct and one round of indirect CO2 emissions capture most of the pollution emitted in production. The advantage to using direct and one round of indirect emissions is that it is easier to calculate than the full direct and indirect effects. Electricity used as an intermediate is the main source of indirect CO2 emissions.

Next, we consider a climate club in which members adopt a carbon tax and impose punitive tariffs against all products from non-members. In this case, tariffs can reduce global emissions by inducing non-taxing countries to join the club. However, climate clubs are fragile. When club members are strongly linked to non-club regions through integrated production relationships, in which imports complement domestic goods, they suffer trade losses, adding to the cost of club membership. Furthermore, high punitive tariffs are needed to induce all regions to join the club.

An Environmental Input-Output Stock-Flow Consistent Model for the Danish Economy

Topic: Special Session - Assessing Industrial, Trade and Green Transition Policies Through SFC-IO Models
Author: Simon Fløj THOMSEN

The main objective of this project is to develop an empirical environmental input-output stock-flow consistent model for the Danish economy (EMDE) to test and understand a wide variety of policies with the goal of identifying the different paths that Denmark can take in towards the green transition and pursuit the goal of being carbon neutral in 2050. To do so, we use the detailed IO-tables across time provided by Denmark's statistics to develop an environmental SFC-IO model for the Danish economy. The Stock Flow Consistent approach offers a consistent methodology that relates stocks and flows by way of social accounting and flow-of-fund matrices. We extend the existing SFC framework by integrating a full set of Input-Output (IO) tables, into the modeling framework (see, e.g., Berg et al (2015) and Naqvi (2015), Jackson (2019), Jackson & Jackson (2021)). As this is an empirical model, we first ensure that the detailed IO-tables provided by Statistics Denmark match aggregate measures in the

national accounts. Second, we deflate the IO-tables to 2010 prices, using the IO-data available both in current and last year's prices. The deflated IO-tables allow us to differ between price shocks and unit shocks going through the IO-framework within the model. Third, we integrate environmental accounts into the modeling framework using industry level data provided by statistics Denmark. The model is pre-dominantly demand led in a sense that behavioral equations determine aggregate demand, which then through the IO-framework will determine the supply side. This paper will provide a thorough description of the equations used within the model to set up a dynamic IO framework, consisting of 7 industries, which is then aggregated to model the non-financial sector in the economy. We evaluate the model based on its ability to match actual data. Finally, we perform two shocks in the model, i) a demand shock that is introduced through an increase in government spending, and ii) The cost push shock introduced through an increase in import prices as was experienced by Denmark during the Covid-19.

Leveraging multinational enterprises to reduce the escalating regional carbon inequality in China

Topic: Regional analysis
Author: Kailan TIAN

Multinational enterprises (MNEs) affect inequality as they exert substantial yet unequal economic and environmental effects across different regions. This study estimates the effects of MNEs on China's regional carbon emission inequality relative to value-added gains by adopting a novel interprovincial input-output model that differentiates MNEs activities across China's 31 provinces. We find that over 80% of MNEs concentrated in developed coastal provinces over the 2002–2012 period and the less developed inland provinces which held less than 30% of the total value-added generated by MNEs emitted more than 50% of the total carbon emissions generated by MNEs. Consequently, MNEs exacerbated China's escalating regional carbon inequality during this period. By 2017, a transformative shift occurred as MNEs increasingly relocated to inland provinces and augmented investments in clean technology-intensive industries. This transition significantly mitigated carbon inequality. Furthermore, we highlight the potential to leverage knowledge spillover effects from MNEs to substantially reduce carbon emissions by 8.8%–27.7% and carbon inequality by 12.5%–31.3%. This study provides valuable policy insights at both global and national levels, suggesting the strategic deployment of MNEs to address inequality and climate change—crucial goals in sustainable development.

Carbon Footprint Analysis of Bilateral International Migration Flow to the U.S.A.

Topic: Regional analysis
Author: Haruka TODA
Co-Authors: Futu FATURAY, Shigemi KAGAWA, Manfred LENZEN, Keitaro MAENO, Waka NISHIFUJI

The United Nations reported that the proportion of international migrants in the total population increased from 2.8 percent in 2000 to 3.5 percent in 2019. It also highlighted that the largest number of international migrants (51 million) resided in the United States, accounting for 19 percent of the world's total.

On the other hand, UNEP reported that per capita consumption-based GHG emissions are highly unequal between and within countries. In addition, since GHG emissions from household

consumption account for more than two-thirds of total global GHG emissions (Ivanova et al., 2016, Hertwich and Peters, 2009), transitioning to a low-carbon lifestyle is necessary to achieve the 1.5℃ goals of the Paris Agreement. Especially, the U.S. has extremely high per capita CO2 emissions and one of the most carbon-intensive lifestyles in the world, while attracting large numbers of immigrants from around the world.

An important research question is how the lifestyle of immigrants changes before and after migration and the extent to which these changes affect the net change in CO2 emissions. While some studies estimated the carbon footprint of international migration and found that the United States contributed the most to the increase in carbon footprint, no study has yet focused on the U.S. and analyzed its impact in detail.

The novelties of this study are as follows: Firstly, we constructed a new dataset by combining the U.S. immigration flow database with an environmentally-extended multi-regional input-output table. Secondly, we estimated the net change in consumption-based CO2 emissions associated with immigration between specific regions of the world and U.S. states (i.e., the difference in the consumption-based emissions of immigrants before and after migration). In doing so, we used Global-MRIO (Eora26), US-MRIO, immigrant stock data provided by the United States Census Bureau and world population data (World Bank).

To the best of our knowledge, this study is the first attempt to estimate the state-by-state impact of the net carbon footprint, with a focus on differences in lifestyle, industrial structure, and immigrants' structure (i.e., how much of the immigrants come from which regions) in each U.S. state. We found that immigrants to the U.S. contributed to an increase in the net change in carbon footprint in 35 states in 2017, with an overall increase of about 15 Mt-CO2. Texas contributed to the increase in the net carbon footprint the most (+2,375 kt-CO2), followed by Florida (+2,235 kt-CO2). The impact of this increase accounted for 27% of the total increase in the carbon footprint.

There were also differences in characteristics. In Texas, more than half of the increase in carbon footprint was generated by immigrants from Central America and South-Central Asia to the U.S., whereas in Florida, the increase was mainly caused by immigrants from South America and the Caribbean.

On the other hand, some states contributed to a decrease in carbon footprint, with California having the most significant negative impact on the net carbon footprint (-754 kt-CO2). This result can be explained by the substantial outflow of immigrants from Mexico, influenced by policy changes associated with the shift in government in 2017. Thus, even within the U.S., different states have markedly different situations in terms of the number of immigrants they receive (or outflow) and their places of origin, significantly impacting the differences in the carbon footprint of each state. This fact is crucial for reducing consumption-based emissions by immigration.

Finally, based on the findings, this study suggests a more comprehensive and sustainable immigration policy, including a carbon tax policy that focuses on the lifestyle of immigrants, rather than a simple limit on the number of immigrants.

A structural decomposition of imports in Argentina: the role of autonomous demand, income distribution and productive integration (1953-2018)

Topic: Structural Decomposition Analysis
Author: Matías TORCHINSKY LANDAU

The lack of foreign currency can be one of the most significant constraints on growth for a small open economy. We study imports' growth, the main source of demand for foreign currency, by applying a novel structural decomposition analysis to Argentina's input-output matrices based on a Sraffian supermultiplier growth model for the period 1953-2018. We find that the main long run determinant of imports is autonomous demand, through its influence on output. Income distribution does not play a significant role in the long run, but it does so in the short run. The deindustrialization process started in the mid-70s deepened the impact of autonomous demand on imports, reducing the external space to boost output through government spending and/or higher real wages.

On the Role of Profits-Wages Ratios in the Determination of the Long-Run Behavior of International Relative Prices

Topic: Input-Output Theory and Methodology
Author: Luis Daniel TORRES
Co-Authors: Jacobo FERRER HERNANDEZ

This paper reconstructs and evaluates the theory of international relative prices (IRP) based on the theory of real competition, one of the approaches to international trade based on the principle of absolute advantages. The main thesis of this theory is that the long-run behavior of IRP of any pair of tradable commodity bundles is determined solely by their relative total unit labor costs (RTULC). This thesis relies on the hypothesis that the total profits-wages ratios (TPWR) of commodities within countries are sufficiently similar. The theory provides several theoretical and empirical arguments supporting that hypothesis.

We identified a set of problems that questions the long-run neutrality of the TPWR on IRP. Firstly, due to accounting reasons, the proposed hypothesis cannot constrain IRP to depend solely on the RTULC –that is, they end up depending on the TPWR between countries. Secondly, the theoretical and empirical arguments advanced to constrain the TPWR are weak –none of these arguments can make the TRWR of any two commodities, within and between countries, to be sufficiently similar. Thirdly, the paper conducts a large-scale study of industries' TPWR and reports that the variability (i) of these ratios and (ii) of their central tendencies, although limited, do not support the constraints necessary for the validity of the theory's main thesis. The paper argues for the use of full production prices for the study of IRP based on the principle of absolute advantage.

Network analysis of the tourism-related activities of the Greek Economy

Topic:
Author: Theodore TSEKERIS
Co-Authors: Nikolaos RODOUSAKIS, George SOKLIS

Tourism is regarded as a main growth engine for the economy of services export-dependent countries such as Greece. The network analysis of the intersectoral input-output relationships and the hierarchical clustering of sectoral activities can support policy proposals on the efficient resource allocation, the enhanced diffusion of growth, the creation of synergies and the broadening of a country's productive base. This paper presents an original network analysis of the tourism ecosystem in the Greek economy, taking into consideration recent concerns about its sustainable development and the extent of its local economic footprint. The data used here refer to the most recently available (for year 2015) symmetric input-output table of the Greek economy. This type of quantitative analysis allows us to identify the central (influential) position of tourism-related activities in the whole economic system, between groups and within the group of sectors that is clustered.

The present analysis demonstrated the existence of a handful of well-defined distinct, tightly knit groups (clusters) of major sectoral activity clusters, encompassing those of Services (primarily of the public sector), Trade (including logistics, real estate management and financial services), Construction (including construction activities and related products and services), Tourism, and Energy. The tourism-related activities in the Greek economy are mainly concentrated in Agriculture, forestry and fishery products, Food and beverages, and Accommodation and food services, together with the Services provided by organisations, and the Paper products, printing products, chemicals, and advertising services.

The tourism-related cluster significantly influences (feeds) all the other main sectoral groups of the country, while −to a lesser extent− it is influenced by other sectoral groups (but significantly only by the wholesale and retail trade services, logistics, real estate management and financial services). The latter outcome suggests that major exogenous shocks in the tourism industry group, such as that experienced during the COVID-19 pandemic, would have significant effects on all other groups of sectoral activities in the Greek economy. Besides, improvements in Accommodation and food services and other closely related tourism activities are expected to have a significant spillover effect on the whole Greek economy.

Furthermore, this finding suggest that the Greek economy can be considered as well concentrated around a few sectors, since only 10 of them account for more than the half (51%) of the total strength (weighted degree centrality) of the overall system. Specifically, Accommodation and food services is found to be one of the strongest sectors in the Greek economy (ranked 5th in order), the most outward-looking sector in its own group, and the sector with the highest degree of modality vitality, which represents the ability to maintain the structure of the tourism-related cluster, together with the sectors of Food, Beverages and Tobacco Products, and Agriculture, hunting and related service activities.

Last, for the measurement of the robustness or change in the strength of sectors after an exogenous shock in tourism, the method of the hypothetical extraction of the Accommodation and food services sector from the network of the Greek economy was used. The results demonstrate that almost half of the sectors with the largest change in strength (greater than 10% reduction) belong to the cluster of tourism-related activities, such as Printing and recording media (-26%), Food, beverages and tobacco products (-20%), Services furnished by organisations (-19%), and Fishing and related products and services (-14%).

The present findings verify the potential of linkages and synergies among agrifood, accommodation and food services, and other related (creative) industries through the

development of a cohesive policy to enable integration and convergence among these sectors to take place. Specifically, the networking of tourism-related activities, through the development of robustly integrated value chains −mainly among the agrifood sectors and the accommodation and food services− at all stages of production of tradable goods, is expected to activate complementarities and synergies, combining their comparative advantages, and promoting knowledge diffusion and innovative practices.

Economic and Environmental Impacts of Sugar Consumption in the United States

Topic: Sustainable Production and Consumption Policies
Author: Kaoru TSUDA
Co-Authors: Shigemi KAGAWA, Yusuke OGA

The World Health Organization (WHO) recommends that the daily intake of free sugars for adults and children should be less than 10% of the total energy intake. However, data from the Food and Agriculture Organization (FAO) reveals that the daily sugar intake per person in the United States exceeds the WHO's recommended limit by nearly 5%. This highlights the concern over excessive sugar consumption in the United States.

The excessive consumption of sugars not only affects health through the overproduction and consumption of sugar but also has the potential to impact the environment through the sugar supply chain. The Industrial Decarbonization Roadmap in 2022, published by the United States Department of Energy, states that the sugar sector is one of the energy-intensive sub-sectors.

Furthermore, the Intergovernmental Panel on Climate Change (IPCC), in its Sixth Assessment Report, stated that to achieve the 1.5-degree target of the Paris Agreement, a 60% reduction in greenhouse gas (GHG) emissions is necessary by the year 2035. Particularly, the oversupply of food is causing excessive CO2 emissions throughout the supply chain of the food industry. To reach the 1.5-degree target, it is imperative to consider specific measures within global food plans to reduce CO2 emissions.

To the best of our knowledge, few studies have estimated the amount of CO2 emitted from the excessively sugared supply chain. This study serves as a first step in examining sustainable food supply plans by focusing on sugar consumption in the United States. The novelty of this study is to estimate the economic and environmental impacts on the sugar supply chain. The study aims to provide policy recommendations for an ideal sugar supply plan in the United States.

To estimate the sugar demand for each industrial sector in the United States, we created a Hybrid Supply-Use Table (SUT) that includes the sectoral supply and use of sugar in physical terms (in tons). In this calculation, we incorporated the final demand (in US dollars) for the "Sugar and confectionery" sector from the Input-Output table and used the 2019 data on sugar consumption in the United States. The sugar consumption in the United States is based on the data published by the United States Department of Agriculture (USDA) for the year 2019 and the Use Table from the Bureau of Economic Analysis (BEA), as published in 2017.

The results from the estimation of the physical amount of sugar demand show that the gross sugar demand in the United States was approximately 11 million tons. The sector with the highest value is the Personal consumption expenditures (7.84 million tons), representing 71% of the domestic annual consumption. Subsequently, the processed food industry, including sectors

such as the Sugar and confectionery product manufacturing (1.35 million tons), the Bread and bakery product manufacturing (0.37 million tons), and the Cookie, cracker, pasta, and tortilla manufacturing (0.34 million tons), exhibited high values.

The sectors with higher direct input coefficients for sugar have also been identified. The sector with the highest value was the Sugar product manufacturing (36.4 tons/USD) sector. Subsequently, industries with high sugar consumption, Cookie, cracker, pasta, and tortilla manufacturing (13.1 tons/USD), the Breakfast cereal manufacturing (8.7 tons/USD), the Bread and bakery product manufacturing (8.6 tons/USD), also revealed significant direct input coefficients.

Based on the above results, it has become evident that essential daily consumed foods at home, such as bread, pasta, and breakfast cereals, contain a significant amount of sugar. Importantly, we conducted a hypothetical extraction analysis of reducing a hybrid input coefficient of specific sugar-intensive food products by 5%, recommended by the WHO, and estimated a reduction potential of CO2 induced by household consumption of food products in the United States. We found that the Cookie, cracker, pasta, and tortilla manufacturing sector had a considerable CO2 reduction impact by reducing its sugar use.

Therefore, the reduction in sugar consumption necessary for food products remarkably contributed to human health in the U.S. people as well as the CO2 mitigation. The government needs to assess the excessive addition of sugar in the production processes of these foods. This reassessment of the sugar industry supply chain can also be effective in reducing CO2 emissions.

A Supply Chain Network Analysis of Energy Cost Propagation in Japan

Topic: YSI and Development Programme II (Discussant: Y. Okuyama and U. Temursho)
Author: Aoi TSUKIOKA
Co-Authors: Shigemi KAGAWA

The primary energy prices of crude oil, coal, and natural gas increased by more than 100% in Japan between 2015 and 2023. Japan, with limited natural resources, relies on imported resources for over 95% of its domestic primary energy needs. Consequently, Japan is highly vulnerable to price increases in imported energy resources. As a result, the Japanese economy has experienced a rapid increase in energy prices due to insecurity in the global energy supply.

The average prices of imported crude oil, coal, and natural gas in Japan increased significantly by 173%, 316%, and 129%, respectively, during the period from 2015 to 2022. A rapid increase in energy prices significantly affects the production costs of a wide variety of industries. This is because they directly and indirectly utilize primary energy sources such as crude oil, coal, and natural gas within their product supply chains. Additionally, commodity prices rise due to inter-industry cost pass-through processes.

A crucial research question is how to identify the most vulnerable industries and supply chains in Japan affected by the recent energy price shock during the study period from 2015 to 2022. To address this research question, we focused on a cost pass-through network structure that explains how a business entity changes the price of its own commodity in response to an energy price shock. The novelty of this study lies in three aspects. First, this study follows the backward-type unit structure model (see, e.g., Ozaki, 1980; Kagawa et al., 2013) and introduces a

new forward-type unit structure model that utilizes the input-output price model, known as the forward-type input-output model. This forward-type model enables us to formulate a unit structure depicting direct and indirect inter-industry cost pass-through processes. Second, this study is the first attempt to quantify the impact of the surge in primary energy prices for crude oil, coal, and natural gas during the study period using the Leontief input-output price model. Based on the forward-type unit structure model, we further identified industries and supply chains facing greater pressure from cost increases due to current energy price hikes. Third, we conducted cluster analysis on the estimated unit structures and clarified several clusters (i.e., appropriate policy targets) as hotspots of the cost propagation.

This study utilized a time series dataset for the imported primary energy prices of crude oil, coal, and natural gas to calculate the average price indices of imported primary energy between February 2022 and February 2023, with the reference year of 2015. This study also utilized the input-output table (IOT) with the highest sector resolution, comprising 373 commodity sectors for Japan in the year 2015.

The results show that crude oil-related products, such as ‘petroleum products (64.7%)’ and ‘basic petrochemicals (22.3%),’ construction materials like ‘paving materials (19.9%)’ and ‘crushed stones (8.9%),’ and transportation services such as ‘air transport (9.6%),’ experienced substantial price-increasing effects when the imported crude oil price rose during the study period from 2015 to 2022. Based on the forward-type unit structure analysis, we further found that ‘basic petrochemicals’ and ‘paving materials’ played a crucial role as hub sectors with larger cost pass-through in the supply chain networks. In addition, there were significant price increases in ‘coal products (254.8%),’ ‘electric power generation for domestic use (67.2%),’ ‘cement (47.7%),’ and ‘iron casting (33.8%)’ during a rise in imported coal prices throughout the study period. On the other hand, price hikes in ‘production and distribution of gas (56.1%)’ and ‘commercial electric power generation (30.5%)’ were substantial during an increase in imported natural gas prices. The industry cluster analysis revealed the iron and steel-related cluster as a strongly-connected cluster with significant cost propagation for all three energy resources: crude oil, coal, and natural gas.

One of the most significant findings is that upstream and midstream industries in crucial supply chains bear cost burdens without receiving financial support. Consequently, the Japanese government should implement policies to provide financial assistance to the most vulnerable industries and supply chains, including petrochemicals, road paving, cement, iron and steel, and domestic electric power generation. Importantly, we recommend that the Japanese government increase investments in greener technology to reduce dependence on fossil fuels in the identified vulnerable industries and supply chain paths outlined in this study.

The Productivity Analysis of Eco-feed Production Technologies in Japan

Topic: Energy Policies
Author: Junji TSURU
Co-Authors: Shigemi KAGAWA, Tomoaki NAKAISHI, Daigo USHIJIMA

In 2022, Japan imported 75% of its livestock feed, comprising 30-60% of livestock industry expenses, with swine production relying on imports up to 63%. Persistent dependence poses a risk of increased domestic feed prices. The government targets a 34% feed self-sufficiency rate by 2030. Eco-feed, utilizing food waste, is proposed to boost self-sufficiency, reduce feed costs,

and cut food waste. However, concerns arise about the suboptimal efficiency and inadequate management of Eco-feed production facilities.

Few studies have attempted to estimate the production efficiency of Eco-feed production plants (e.g., Nakaishi and Takayabu, 2022). This study focuses on scrutinizing the production efficiency of Eco-feed plants. It involves the identification of both efficient and inefficient plants, along with a quantitative estimation of the potential for cost reduction linked to the elimination of inefficiencies. Additionally, we assess both the efficiency of production technology and production scale. We offer recommendations for enhancing production efficiency and propose efficient plants as benchmarks for those facing inefficient operations.

In this research, employing Data Envelopment Analysis (DEA), we conducted a production efficiency analysis encompassing a total of 45 plants. This includes 28 plants with the dry method, 11 plants with the liquid method, and 6 plants with the fermentation method. It is important to note that although Nakaishi and Takayabu (2022) identified inefficient Eco-feed plants in Japan, they did not distinguish between Eco-feed production technologies. Therefore, Nakaishi and Takayabu (2022) failed to establish a reference Eco-feed production frontier for a specific Eco-feed production technology. The novelty of this study is twofold. First, this study is the first attempt to examine the production efficiency with a focus on a specific Eco-feed production technology. Second, we revealed cost reduction potential achieved through improving the production technology of the inefficient Eco-feed plants identified in this study.

We compiled a comprehensive input-output database for the production activities of 45 specific Eco-feed plants in Japan. This database includes two inputs, namely the number of employees (person) and the amount of biomass delivered (t), and one output, which is the amount of Eco-feed produced. Additionally, we calculated a normalized efficiency score ranging between 0 and 1 for the 45 specific Eco-feed plants via DEA.

This study utilized two DEA models: the Constant Returns to Scale model and the Variable Returns to Scale model. The adoption of these models enables the estimation of three efficiency types: Overall Technical Efficiency (OTE), Pure Technical Efficiency (PTE), and Scale Efficiency (SE). This facilitates the identification of whether inefficiencies arise from production technology or production scale. The cost reduction potential was calculated by subtracting the OTE efficiency value from 1, and subsequently multiplying the result by the costs associated with Eco-feed production, encompassing labor and transportation expenses.

Based on the results, the average OTE scores were 0.44 for the drying method, 0.52 for the liquid method, and 0.47 for the fermentation method, with 37 plants scoring below 1. This suggests that there is room for improvement in many plants. Additionally, the average PTE scores were 0.62 for the drying method, 0.75 for the liquid method, and 0.62 for the fermentation method. The average SE scores were 0.74 for the drying method, 0.67 for the liquid method, and 0.68 for the fermentation method. This indicates that for the drying and fermentation methods, SE is higher than PTE.

This implies that there is potential for improvement in production technology rather than scale economies for the drying and fermentation methods. Conversely, in the liquefaction method, the lower PTE compared to SE suggests a potential for improvement in production scale. Moreover, concerning the reduction potential, for the drying method, liquid method, and fermentation method, labor costs could be decreased by 693 million yen, 404 million yen, and 250 million yen, respectively. Additionally, it was determined that transportation costs (number of trucks per day) could be reduced by 57, 39, and 0.47 for each respective method.

This study revealed the potential for cost reduction, encompassing labor and transportation costs, in inefficient plants. We also offered guidelines on whether to enhance production technology or production scale to improve the productivity of inefficient plants. Consequently, inefficient plants should seek inspiration from efficient reference plants and make improvements in either production technology or scale to boost production efficiency. This, in turn, could contribute to an elevation in Japan’s feed self-sufficiency rate, a further reduction of food waste, and a potential decrease in feed prices.

Measuring the level of participation of semiconductor industry in Japan and Taiwan in Global Value Chains

Topic: Trade and Global Value Chains Policies
Author: Yoko UCHIDA

The rapid expansion of global trade volumes since the 1990s has been driven by the division of production between processes, in which the production of a single good is divided into multiple processes, each located across national borders. Developing countries have been incorporated into global value chains (GVCs) by participating in the processes appropriate to their capital-labor conditions within the segmented processes, thereby providing them with opportunities for economic growth.

East Asian countries have achieved economic growth through participation in GVCs. In particular, the semiconductor industry in Taiwan has shown remarkable growth, while Japan's has been in decline.

This study attempts to clarify why Taiwan's semiconductor industry grew sufficiently, and in contrast, what happened to the Japanese semiconductor industry and how this affected the Japanese economy.

The study uses a Japan-Taiwan bilateral input-output table, in which the domestic input-output table for Japan and Taiwan covering the year 2016 is used to create an original 87-sector Japan-Taiwan international input-output table, and the created table is divided into production sectors by trade mode using data from the Census of Economic Activity Survey. This Japan-Taiwan table by mode of trade has independent sector classifications for semiconductors and semiconductor production equipment, allowing a more detailed semiconductor industry analysis. The analysis uses the Trade in Value Added (TiVA) indicator to reveal the characteristics of the Taiwanese and Japanese semiconductor industries.

The results of the analysis show that the forward participation of the Japanese semiconductor industry in GVCs is lower than that of Taiwan. If the heterogeneity of firms is considered, Japan's forward participation rate is even lower than Taiwan's.

Supply Chain Network Analysis of Carbon Tax in Japan

Topic: Energy Policies
Author: Sho UEHARA
Co-Authors: Shigemi KAGAWA, Aoi TSUKIOKA

The Japanese government is focusing on carbon pricing to achieve carbon neutrality. A carbon tax, one method of carbon pricing, puts a price on CO2 emissions, providing an incentive to reduce emissions. The Japanese government plans to introduce a carbon tax in 2028, targeting five domestic industries: Petroleum refinery products (i.e., crude oil wholesaler), Coal products

(i.e., coal wholesaler), Electricity (i.e., power supply industry), Gas supply (i.e., city gas), and trading companies.

The tax amount is determined based on the CO2 emissions from fossil fuels imported by these industries. The carbon tax payment imposed on upstream industries will be passed on to downstream industries through supply chain networks, affecting middle and downstream industries that utilize products from upstream industries. Therefore, it is crucial to focus on the impact of the ripple effect on the economy and the environment. This study aims to identify how a carbon tax would influence the Japanese economy and the environment.

In this study, the effects of a carbon tax imposed on four industries: petroleum refinery products, coal products, electricity, and gas supply were analyzed. Firstly, we estimated the monetary and physical amounts of fossil fuels imported by each of the four industries using the detailed physical input-output table of 2015. Secondly, we calculated the amount of carbon dioxide potential directly emitted by the four industries using the carbon dioxide emission factor provided by the Ministry of the Environment of Japan. From the CO2 emission potential, the amount of carbon tax payment that would be imposed on the four industries was estimated.

As the carbon tax rate has not been determined in Japan, we assumed a carbon tax rate following the rates introduced in EU countries. To consider the ripple effect, we quantified the increase rate of 373 domestic products using both the input-output price model and the supply-chain network model based on the price model. Additionally, we identified the cost pathway of the ripple effect using Structural Path Analysis. Finally, we identified the potential reduction in CO2 emissions due to changes in final demand for each domestic product, considering the relationship between the price of the product and the demand for the product.

While many studies describe the advantages and disadvantages of carbon taxes, few of them identify the economic and environmental effects of a carbon tax in the complex supply chain. From a result based on the 2015 input-output tables of Japan, we found that the total Carbon Footprint of fossil fuels imported by the four industries including Petroleum refinery products, Coal products, Electricity, and Gas supply was about 926 Mt-CO2e. If a carbon tax of 2,890 JPY per ton of CO2 emissions (i.e., the least carbon tax rate in the EU countries) is applied to the four industries, a total carbon tax payment of 2,678 billion JPY would be imposed in Japan.

Furthermore, it is estimated that the average price in Japan would increase by 1.9% through supply chain networks, with “pig iron” experiencing the highest price increase at 17%. In addition, we found that price increase rates in the supply chain groups would be particularly high around iron and steel industries including “pig iron,” “crude steel (converter),” and chemical product industries including “basic petrochemicals,” and “petrochemical aromatics”. It is important for these industries to reduce CO2 emissions so that they can mitigate their own carbon tax burdens. Based on the results of this study, we suggest that the government should provide financial support to improve energy efficiency within the supply chain groups identified in this study and determine the best way to operate a carbon tax.

Life-cycle CO2 and Cost Reduction Potential through Operational Efficiency Improvements via Data Envelopment Analysis in the Japan’s medical sector

Topic: Sustainable Production and Consumption Policies
Author: Daigo USHIJIMA
Co-Authors: Haruka MITOMA, Tomoaki NAKAISHI, Shigemi KAGAWA

In 2021, the Japanese population aged 65 reached 36 million, constituting 29% of the total population. Moreover, the number of Japanese individuals aged 65 years and above is projected to continuously rise, with the proportion of older adults expected to reach 35% by 2040. Consequently, there will be an increased demand for healthcare services catering to older adults. Modern medical services rely on diagnostic imaging equipment for disease detection and post-treatment observation, with general clinical imaging devices providing swift and accessible physical information. Specifically, Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) offer detailed cross-sectional images of the human body.

The number of CT units In Japan were 6.8K in 1990 and 20.2K in 2020, while the number of MRI units was 756 in 1990 and 7.2K in 2020. This signifies a remarkable increase of 114% for CT and 860% for MRI over the past 30 years. Considering the advancing aging society in Japan, the introduction of CT and MRI units in hospitals and clinics is expected to continue growing. However, there is substantial variation in the number of CTs and MRIs per population across prefectures, with a negative correlation observed between the number of examinations per unit and the number of CTs and MRIs per population. This suggests inefficient operation of CTs and MRIs on a national scale, and there may also be variations in operational efficiency at the prefectural level. Inefficient use of medical devices could lead to excessive lifecycle CO2 emissions.

In 2011, CO2 emissions from the Japanese healthcare sector amounted to 62.5Mt-CO2, and these emissions increased by 16% between 2011 and 2015. CO2 emissions from the healthcare sector in 2015 constituted 5.4% of Japan’s total CO2 emissions, equivalent to the direct CO2 emissions from the private car sector (Nansai et al., 2020). To reduce the carbon footprint of healthcare services, efficient utilization of medical devices is crucial. To the best of our knowledge, this study is the first attempt to assess the operational efficiencies of CT and MRI in each of the 47 prefectures in Japan using Data Envelopment Analysis (DEA) and to estimate the potential reduction in CO2 emissions and costs by minimizing unnecessary CT and MRI usage in each province.

The empirical results based on a comprehensive hospital database covering 47 prefectures of Japan show that the average operational efficiencies of CT and MRI nationwide were 0.72 and 0.77, respectively. Furthermore, the eastern regions of Japan exhibited higher operational efficiency scores, while lower scores were predominant in the Kyushu and Shikoku regions, highlighting a substantial efficiency gap in Japanese hospitals. The DEA scores estimated a total reduction potential of 3,410 units (23% of the total) for CT and 1,215 units (17% of the total) for MRI in Japan.

The combined reduction potential for equipment- and electricity-derived CO2 from minimizing unnecessary CT and MRI usage in Japan was 545 kt-CO2, constituting approximately 1% of the medical sector's life-cycle CO2 emissions in the country. Notably, a significant percentage of Japanese hospitals expressed limited interest in future energy reduction opportunities. Despite the government's emission intensity target of a 1.57% reduction, the study concludes that there

is substantial potential for CO2 emission reduction through the efficient use of capital equipment in Japan's medical sector.

Furthermore, the nationwide potential for cost reduction, based on the reduction potentials of CT and MRI, was estimated at 313 billion yen. This amount is equivalent to about 90% of the total medical deficit of all university hospitals, suggesting that inefficient equipment operation may be placing strain on hospital management.

The study highlights that the inefficient operation of medical imaging equipment, such as CT and MRI, in Japan leads to excessive environmental burden and costs. In Japan, there are no laws restricting the introduction of medical devices. Therefore, to maintain the operational efficiency of the equipment, Japan should refrain from introducing new devices. Additionally, in order to reduce environmental impact and costs, each local government should consider reallocating existing medical equipment and promote collaborative use of devices among hospitals to ensure their efficient utilization.

Bridging the gap between stock-flow consistent models, input-output analysis and environmental accounts: an empirical application to the case Colombia

Topic: Special Session - Assessing Industrial, Trade and Green Transition Policies Through SFC-IO Models
Author: Sebastian VALDECANTOS

Both the stock-flow consistent (SFC) approach and input-output (IO) analysis share the feature of describing the economy as a web of interactions between social and economic agents. This way of understanding economic processes provides much richer insights than the more mainstream approaches based on methodological individualism, where structural features and sectoral and agent heterogeneities are mostly lost in the abstraction of the representative agent. Moreover, SFC and IO analyses are strongly grounded on national accounting, ensuring the fulfilment of key accounting identities that help guarantee the coherence of the results generated by the models. However, there are a number of differences that have kept SFC and IO analysis as two separate modelling strands. First, while SFC models have mostly assumed a single-good economy, IO models are multisectoral by definition. Second, since most SFC models have been developed by scholars belonging to the Post Keynesian school, production has been assumed demand-led with little attention to potential supply-side constraints. Although in IO analysis production can also be considered demand-led, their multisectoral description of the economy allows for a much more detailed analysis of the supply-side implications of a specific vector of final demand. Third, while IO models tend to be static, the SFC approach emphasizes the importance of understanding the economy as a dynamic process. Finally, while IO models focus on the real side of the economy (mostly on production relationships), SFC models have mostly prioritized the description of current and financial transactions.

The aim of this paper is to build a bridge between these two different though complementary modelling approaches using Colombia as a case study. To do this, we combine the Integrated Economic Accounts (IEA) provided by DANE, usually used in the SFC approach, with the IO tables provided by OECD Stat. This requires making several assumptions to harmonize the notion of "institutional sectors" used in the (IEA) with the activities reported in IO tables. The most challenging task is to define a balance sheet and a flow-of-funds for the different productive sectors in which the "nonfinancial corporations" sector is disaggregated. The balance sheets of

individual firms published by the Ministry of Trade are used to do this. This data is further used to make the required assumptions to define interest payments for each productive sector. Moreover, the satellite environmental account is used to incorporate each productive sector's greenhouse gas emissions. All these data sources and decision criteria to harmonize them are combined to build an empirical SFC-IO model for Colombia for the period 2005-2018. We expect this paper to contribute to the economic modelling literature by establishing a clear methodological procedure on how to combine the different data sources required to build an SFC-IO model.

Impact simulations with the multiregional matrix of Colombia 2018

Topic: Regional Analysis
Author: Jaime VALLECILLA

An Income Corrected Social Accounting Matrix

Topic: Income distribution policies
Author: Diego VASQUEZ
Co-Authors: María C. DELGADO, Pablo GUTIéRREZ

Is the social accounting multiplier analysis and its derivatives sensitive to underreporting and nonresponse in the income distribution? We propose a new method to correct the multipliers of a social accounting matrix for underreporting and nonresponse in the income distribution. To do so, we combine a recent imputation technique developed by Blanchet, Flores, and Morgan (2022) with traditional social accounting multiplier analysis. We apply this method to the Chilean economy to study the effect of government transfers on the income distribution using Holst and Sancho's (1992) framework. We utilize national accounting data along with survey data from the CASEN survey for 2017. Without correcting the income distribution, government transfers appear to improve all quintiles of the income distribution. However, when we apply this methodology, government transfers only improve the first four quintiles. This implies that our method can provide a more accurate depiction of the effect of government transfers on the income distribution.

Implications of Taxation Alternatives in India’s Energy Transition: ESAM Analysis

Topic:
Author: Rajat VERMA
Co-Authors: LAVEESH BHANDARI

India has pledged to achieve net zero by 2070, which will have fiscal implications as revenue generated by fossil fuels accounts for 3.2% of its GDP. Hence, one also needs to examine the Fiscal transition along with the energy transition. This study addresses the critical question of how the replacement of existing fossil fuel taxes with various indirect tax options will impact the economic efficiency, emissions intensity and equity (E3) across households groups. While previous research has explored the potential impacts of introducing new eco-taxes, this study introduces a novel perspective by evaluating the effects of replacing existing fossil fuel taxes with alternative taxation strategies, particularly within the unique context of India using an

Environmentally-extended Social Accounting Matrix (ESAM) approach .

This paper uses the aggregated version of the ESAM for India 2019-20 which has 45 production sectors, 32 labour categories and 40 classes of households, categorised based on region, social groups and annual consumption, thereby allowing us to analyse the equity implications of taxation alternatives. The environmental accounts within the ESAM provide a deeper understanding of how these tax alternatives will impact the environment. The impact on key macroeconomic variables and the environment is assessed using the modified multiplier model, and the distributional impacts on households are assessed using the price-vector model. Using these methods, we estimate the potential impacts of replacing existing fossil fuel taxes for seven different tax options which can be categorised under Carbon Taxes, User Taxes and Goods and Services Taxes (GST).

Preliminary results indicate that replacement with any tax will impact the welfare of households by impacting their tax burden although the impact is progressive in almost all the scenarios. The extent of impact varies greatly with the nature of the tax and the tax base. Overall, these scenarios depict marginal impacts on the GDP coupled with a small yet noticeable decline in emissions intensity and fiscal deficit across most scenarios. However, when we replace fossil taxes with emissions taxes either with distance travelled taxes or by a combination of distance travelled and electricity use, we observe that the tax shifts lead to a slight increase in the GDP, a decrease in the overall tax burden along with a decrease in the emissions intensity.

From Global Conflict to Household Impact: The Czech Energy Crisis in the Wake of the Russian-Ukrainian War

Topic: Price and Income Policies
Author: Iñaki Alberto VERUETE VILLEGAS

In the wake of the Russian-Ukrainian conflict, profound changes are sweeping through the European energy landscape, significantly impacting economies dependent on energy commodity imports like the Czech Republic. In particular, the onset of the war was characterized by an unprecedented surge in natural gas, and more broadly, energy prices. Beyond the burden directly imposed on households by high energy prices, average prices of electricity and gas for industry more than doubled and tripled, respectively, by the end of 2022, compared to 2020 levels. As a consequence, energy inputs needed for the production of goods and services for households' final consumption may contribute to higher prices of household-expenditure items.
This paper aims to investigate the short-to-medium-term economic and distributional implications of this conflict on the Czech Republic, a small open economy that, like other European countries, has relied on oil and natural gas imports from Russia.
The study is structured in two primary segments. Initially, we extend the traditional input-output demand model by departing from the usual single representative household and integrate microdata from consumer expenditure surveys as described in [Cazcarro et al., 2022] to attribute the consumption of natural gas and other fuels in production processes to the final consumption of heterogeneous households defined by income deciles and yearly expenditures deciles, which may provide a better proxy for permanent income and has been suggested to be less sensitive to temporary situations. The inclusion of heterogeneous households in multisectoral models is pivotal for investigating the unequal burden experienced by households along the income distribution, particularly given their consumption patterns. Though the literature on the potential impacts of the Russian-Ukranian conflict on the energy system and the econ-

omy at different geopolitical scales is somewhat large, few studies have applied quantitative modeling techniques to investigate the heterogeneous effects of the conflict on households. Among the existing literature, a notable example is the paper by [Guan et al., 2023], which employs a global multi-regional input-output model database and household expenditure data to model the impacts of increased energy prices on heterogeneous households. Nevertheless, their modeling approach is unable to capture households' behavioral responses to the changing prices.

To gain insights into households' reactions to changing prices concerning their consumption decisions, in the subsequent phase, we link the ripple effects across various sectors of escalated energy prices estimated via an input-output price model to the static microsimulation optimization model DASMOD (Distributional And Social Impact Model), which allows for the estimation of social impacts of the rising energy prices according to income, income 1
distribution, household expenditures, and potential fiscal effects [Ščasný and Bruha, 2008]. The microsimulation model is based on data from EU-SILC and HBS for the Czech Republic in 2019. Household behavioral responses are captured through price and income elasticities, with the model employing neutral cross-price elasticities. The use of our microsimulation model allows for a more refined exploration of the distributional and welfare effects of the energy crisis.

Ultimately, the study underscores the need for a holistic approach to addressing the challenges posed by energy dependency in the modern geopolitical landscape. The paper concludes by emphasizing the importance of resilience in energy policies, suggesting a need for diversification in energy sources and investment in sustainable energy alternatives to reduce dependency on volatile energy imports, which according to the existing evidence, typically hurts poorer households more than richer ones, as, among other things, tend to generally spend a higher share of their income on energy products, and are thus more exposed to the direct effects of the energy crisis.

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Input-Output Modeling Amidst Crisis: Tracing Natural Gas Pathways in the Czech Republic During the War-Induced Energy Turmoil

Topic: YSI and Development Programme II (Discussant: Y. Okuyama and U. Temursho)
Author: Iñaki Alberto VERUETE VILLEGAS

The current geopolitical landscape, particularly highlighted by the Russian invasion of Ukraine, has brought the issue of energy security into sharp focus, especially for European countries like the Czech Republic, which have historically relied on Russian natural gas. This research aims to dissect the intricate interplay between energy security and natural gas usage in the Czech Republic, providing a comprehensive analysis amidst these turbulent times.

In conducting this study, we employ a domestic input-output model based on the year 2019, which serves as a critical period for understanding the Czech Republic's energy supply chain before the geopolitical upheaval. This model is built on a foundation of diverse data sources, including economic data from Supply and Use tables, physical accounts of natural gas use by Czech industries from the Czech Statistical Office, average natural gas prices for industries in 2019 from Eurostat, and prices from the Title Transfer Facility (TTF) in the Netherlands. The TTF data is particularly significant as it is the primary reference for natural gas trading in Europe, and it enables us to assess the impact of the increase in natural gas prices following the onset of the Russian invasion.

Our approach is multi-dimensional, incorporating both energy input-output demand and price models to unravel the potential economic ramifications in scenarios where the availability of alternative energy sources is constrained. Given the challenges associated with substituting Russian gas, a key aspect of our methodology is the application of network analysis techniques, including node and edge betweenness centrality measures and the hypothetical extraction method. These techniques allow us to pinpoint structurally important elements within the country's natural gas consumption network. Node betweenness centrality is instrumental in identifying critical transmission sectors within supply chains, offering insights into their relative importance based on the amount of embodied natural gas they transmit. Meanwhile, the hypothetical extraction method provides a comprehensive gauge of a sector's significance by simulating the complete removal of its forward, backward, and internal connections, thus indicating its criticality to the economy. Furthermore, the use of Structural Path Analysis (SPA) allows us to trace the flow of purchases of intermediate products instigated by final demand purchases of final products. This SPA approach, combined with energy data, enables us to quantify the embodied energy at each stage of the supply chain, ultimately reconstructing it into a tree-like structure representing energy consumption across different economic sectors.

Our findings reveal significant implications of natural gas price fluctuations on key manufacturing industries in the Czech Republic, notably those engaged in international trade, such as the mineral, chemical, automotive, metalwork, machinery, paper, and rubber and plastic industries. These sectors are particularly vulnerable to energy supply and price disruptions. In parallel, we highlight the crucial role of sectors that provide essential goods and services to households, like energy, food, and transportation. The analysis indicates that strategic interventions may be necessary in the event of severe disruptions to protect both domestic demand and the competitive edge of nationally vital sectors like the automotive industry.

This study underlines the importance of understanding the potential repercussions of interventions at various levels of the country's supply chain. As energy security remains a dynamic and evolving challenge, our research contributes significantly to the ongoing discourse on energy resilience, particularly for countries in Central and Eastern Europe, and provides a framework for other nations facing similar complexities.

SHAPING BRAZILIAN WATER POLICY USING ENVIRONMENTALLY EXTENDED INPUT-OUTPUT MATRIX

Topic: YSI and Development Programme IV (Discussant: R. Duarte and S. Miroudot)
Author: Jaqueline Coelho VISENTIN
Co-Authors: Marcus Andre FUCKNER, Sergio Rodrigues Ayrimoraes SOARES, Marcela Ayub BRASIL, Alexandre Lima de Figueiredo TEIXEIRA, Carlos Alberto GONçALVES JUNIOR, Keyi Ando USSAMI

One of the biggest challenges of the 21st century refers to the sustainable management of water resources (UN-Water, 2021). Brazil concentrates 12% of all fresh water available in the world, presenting a comfortable situation in global terms. However, there is an uneven spatial distribution of this resource in the country. About 80% of its availability is concentrated in the Amazon Hydrographic Region, where there is a small population. This scenario, associated with the current water crises and the projection – presented in the sixth report of the Intergovernmental Panel on Climate Change (IPCC) on August 9, 2021 – of an increase in periods of drought alternating with floods, rising sea levels, desertification of some regions, among others, points to an even greater aggravation. In this context, the demand for information on the mapping of the direct and indirect use of water along the supply chain has been increase. In this context, the calculation of the Water Footprint and Virtual Water flows has occupied an important space. As pointed out in the System of Environmental-Economic Accounting - Applications and Extensions (SEEA-AE) (UN, 2017), the use of the Environmentally Extended Input-Output Matrix (EE-IOT) allows the calculation of Water Footprints and Virtual Water flows over the along the entire supply chain, making it possible to identify the main agents responsible for the use of water resources (FENG et al. 2011). Given these considerations, the objectives of this article are: (i) to identify the main users (direct and indirect) of water, whether located inside or outside the management region; (ii) map the water interdependence between the regions in order to make it possible to estimate the impact of the economy of a given region on the abstraction of water from another region and, consequently, on its Water Balance; and (iii) carry out impact analyzes simulating the impact of increased investments and change in water intensity on water abstraction and the Water Balance. The methodology used refers to the inter-regional EE-IOT, estimated for the year 2017, where Brazil was disaggregated into 3 regions: (i) Rio Grande River Basin; (ii) Paraíba do Sul River Basin (PBS); and (iii) Rest of Brazil (RBR)), considering 24 economic activities. Among the main results, we highlight that, in 2017, the Water Balance of the Rio Grande River Basin was in a worrying situation, with 12.6% of the 744.28 m^3/s of water availability committed to the demand for consumptive uses (93.9 m^3/s), and a relevant part of this consumptive use was destined to the production of goods and services exported to other regions and/or countries (75 m^3/s, or 10.1% of water availability). At the same time, the Water Balance of the Paraíba do Sul River Basin was in a comfortable situation, with 8.9% of the water availability committed to the withdrawal flow for consumptive use. Similarly, demand from outside the Basin itself was the main factor responsible for the criticality classification in the Water Balance (24.2 m^3/s, or 6.6% of water availability). It was verified that the 1% increase in investments in the Brazilian economy can generate a greater impact in terms of water abstraction, value added and employment in the Paraíba do Sul River Basin, when compared to the effects generated in the Rio Grande Basin and in the rest of Brazil. It was also verified the impacts on water abstraction in the Rio Grande River Basin if its 'Water supply, sewage collection and treatment and waste management' activity worked with the same water efficiency as the 'Water water, sewage collection and treatment and waste management' of the Paraíba do Sul River Basin. Among the main results, it was found that there could be a reduction of 370 hm^3 (or 0.561%) in the consumptive use of water in Brazil, representing a reduction in the consumptive use of water in the Rio Grande River Basin of 11.63%. In turn, this result would contribute to the

improvement of its Water Balance, reaching 11%, against the 12.6% recorded. Therefore, approaching the level considered comfortable. Thus, based on the results obtained, the interregional EE-IOT approach has the potential to generate relevant information that contributes to expanding the conceptual and methodological basis used in the management of water resources, bringing new possibilities for investigation and production of relevant information for water management in Brazil.

Carbon emission transfers and mitigation patterns of domestic migration in China

Topic: Sustainable Production and Consumption Policies
Author: Rui WANG
Co-Authors: Xun ZHANG, Xin ZHANG, Jun TANG, Lixiao XU

The carbon footprints of migrant consumption (MCFs) are crucial in achieving carbon peaking and carbon neutrality. In this study, a methodological framework is established through house-hold survey data and an environmentally extended multiregional input-output model to quantify MCFs pre- and post-migration in 30 provinces in 2017. The study also examines provincial and sectoral strategies for reducing emissions. Results indicate that MCFs reach as high as 660 million tons of CO2 equivalent (MtCO2e) (over 6.0% of Chinas total emissions), with rural migrants con-tributing over 60%. Areas that concentrate migrants (e.g., Guangdong, Zhejiang, Shanghai, Jiangsu, Beijing) are facing an overwhelming challenge, and interprovincial migrants are the main source of the transfer-in of carbon emissions. Consumption by migrants predominantly drives emissions in energy-intensive sectors, accounting for more than 46% of total emissions. Reducing the carbon intensity in these sectors is therefore a key starting point in implementing measures to reduce emissions, and it is important in achieving overall control and staged abatement goals.

An inter-city input-output database distinguishing firm ownership in the Greater China area during 2002-2017

Topic: Special Session: IDE-JETRO & Statistics Netherlands Joint Special Session
Author: Yafei WANG
Co-Authors: Bo MENG, Heran ZHENG, Xuguang SONG, Nan ZHAO

China, the largest emerging economy, has considerable variations across cities in their economic structure and level of development. However, most multi-region input-output (MRIO) tables in China focus on provinces or urban agglomerations and cannot reflect the tremendous geographical heterogeneities of economic activities across Chinese prefectural cities, where regional economic centres usually located for domestic and global production. We construct an inter-city input-output (IO) database with 42 sectors in the Greater China area.

Compared with previous work, our database has the following innovations:

First, it uses a variety of microdata to estimate the economic structure of each city covered, including economic census, annual surveys of industrial firms, urban and rural household surveys, and detailed custom trade statistics. These micro-level data are aggregated to obtain estimates for the structure of gross output, value-added, major categories of final demand and imports and exports for every prefectural-level city. The use of such rich micro-level data significantly improves the quality of the constructed IO tables at the city level. In addition, we further combine

the structure estimates from micro data with China's provincial and city-level aggregate statistics as constraints which provide more precise structural shares for production, intermediate and final demand and trade. Such a combined bottom-up and top-down approach also facilitates efficient workflows for the next benchmark year of 2023, in which the fifth China Economic Census and the eighth China Input-Output Survey have been integrated into one undertaking starting in 2023 and can provide more consistent data for the future city-level MRIO compilations.

Second, it applies a three-tier architecture to organize the compilation of the inter-city IO database. The first tier is the raw data for further processing, which stores enormous micro and macro data from various sources. The second tier is the derived data and tables for IO table compilation, including processed data at the city level from the first tier to estimate the sector and firm ownership structure for each prefectural city and external data as constraints such as provincial input-output tables and GDP estimates by production-, income-, and expenditure-methods. In this stage, three series of intermediate data products, i.e., prefectural-city SRIOs by firm ownership for each province (total of 337 SRIOs), provincial-wide prefectural-city MRIOs by firm ownership for 27 provinces and Chongqing, and full city-level MRIOs for mainland China (total of 340 cities), are generated and can be applied to specific research topics elsewhere. The third tier is the final database, i.e., the ownership-based inter-city IO tables including the HMT region for the four benchmark years.

Third, it is the largest inter-city IO table to date in the world. It contains the complete above-prefectural cities in the Greater China area with 335 prefecture-level cities from 27 provinces, four municipalities directly under the Central Government (i.e., Beijing, Shanghai, Tianjin, and Chongqing with separate urban and rural regions, subtotal of five regions in the table) in mainland China, and Hong Kong, Macao and Taiwan (HMT), a total of 343 regions. It is the first time to construct benchmark SRIOs for Macao and harmonize benchmark year and sector classification for Hong Kong's and Taiwan's IO tables with SRIO tables of mainland China, respectively.

Fourth, it is the first city-level IO table with firm ownership information. It distinguishes domestically owned, HMT-owned, and foreign-owned firms for every city and sector for each of the four benchmark years. At China's prefecture-city level, the constructed tables are based on the 42-sector classification consistent with the official input-output classification issued by the National Bureau of Statistics of China, and each sector at the city level identified its firm heterogeneity by firm ownership information. The firm ownership information is determined by registered capital types from firm-level microdata and then aggregated into the three major groups.

Finally, it covers four benchmark years, i.e., 2002, 2007, 2012 and 2017 with a consistent method that can generate more broad applications. It not only provides more possibilities for users to carry out new economic and environment policy-related applications to and/or re-estimations of various topics such as trade in value-added across cities, carbon footprint estimation, and spatial distribution of production and employment in the Greater China area based on the time series of inter-city IO tables, but also provide a new data source for linking city-level IO tables with global ICIO for domestic and global production network analysis and shed light to other large economies with great variations of subnational regions like China to build their own inter-city IO tables.

Disaggregating MRIO table - a novel approach

Topic:
Author: Jan WEINZETTEL
Co-Authors: Birte EWERS, Karl SCHOER, Richard WOOD

Product detail is often seen as a limiting factor in the precision of the results of the input-output analysis as different types of products are aggregated into one group and treated as identical in the production recipe and sales structure. As the disaggregation of MRIOT can be seen as a computationally, data and time-demanding procedure, we aim to answer the research question: How can multi-regional input-output tables (MRIOT) be disaggregated to increase the product or sectoral detail efficiently regarding time and computational capacity?

In this contribution, we present a novel method to disaggregate MRIOT to increase the product detail and make the results more reliable. Before starting the disaggregation, we harmonize the input data on total output, detailed country-by-country international trade, and the original MRIOT. We prepare a set of input coefficients for the disaggregated product groups derived or estimated from existing data. The MRIOT is disaggregated country by country, always taking the block of columns for each country at once. The procedure is taken in the following steps for each country separately: first, the regions of origin (the rows) are aggregated, resulting in the total IOT for each country. An initial estimate of the disaggregated total IOT with the required product detail is obtained from the total output and input coefficients for the detailed product groups. A GRAS algorithm is applied to balance the initial estimate to meet the constraints of row and column totals and the original IOT. Afterward, the product's origin is added, assuming an identical sales structure for the same product originating from different countries. We see this as an important limitation of this approach. Next, the resulting matrix is balanced again using the same balancing algorithm, resulting in a column block of one country's disaggregated part of the MRIO, which complies with the data on detailed international trade, the original MRIOT, and the detailed total output. This procedure is repeated for all countries, resulting in a disaggregated MRIOT.

We successfully applied this procedure to disaggregate the EU part of the Figaro MRIOT from the level of 64 product groups to 182 product groups consistent with the Eurostat RME model to calculate the material footprint of the EU. However, we note that this type of disaggregation is not precise. We performed a test in which we aggregated the Figaro MRIOT from 64 product groups to 10 product groups and then applied our method to disaggregate it back to the level of 64 product groups. This allows us to analyze whether this disaggregation procedure with limited information improves the results of the MRIO analysis. This test proved that our disaggregation method improves the precision of the Leontief inverse matrix.

Research question: How can multi-regional input-output tables (MRIOT) be disaggregated to efficiently increase the product or sectoral detail regarding time and computational capacity?

Method used: We developed a novel procedure for MRIOT disaggregation. We use the existing procedures of creating the initial estimate from the input coefficients and total output and the GRAS algorithm to balance the initial estimate to the three constraints: row total, column total, and the original IOT, allowing negative entries in the column of changes in inventories and valuables.

Limitation: We assume an identical sales structure for the same product originating from different countries.

Data used: We applied this procedure to disaggregate the EU part of the Figaro MRIOT from 64 product groups to 182 product groups.

Novelty: The novelty is in harmonizing the input data before the disaggregation and disaggregating the MRIOT country by country, which significantly reduces the computational requirements.

Productivity and competitiveness in an era of reconfiguration of Global Value Chains

Topic: Trade and Global Value Chains Policies
Author: Ariel Luis WIRKIERMAN

The second ‘globalisation unbundling’ (Baldwin, 2016), which started in the 1990s, transformed the world economy in, at least, three dimensions: global production, national competitiveness and income distribution.

First, globalising factories changed the international division of labour by means of domestic and international outsourcing, creating Global Value Chains (GVCs). Second, driven by competitiveness, the global North de-industrialised, whereas industrialising nations in the global South – led by China – shifted “from a low-tech/low-wage bundle to a high-tech/low-wage bundle” (Baldwin, 2016, p. 216). Third, but equally important, these processes coincided with a declining global labour share.

The recent (and ongoing) supply shocks (i.e., the Covid-19 pandemic and the war in Ukraine) have exposed the vulnerabilities of the current configuration of globalised production and a reconfiguration is taking place, its depth and scope still being assessed. The outcome of such reconfiguration of GVCs is bound to have important consequences for productivity, competitiveness and income distribution.

While competitiveness remains a national concept, production fragmentation makes productivity an international one: when minimising global production costs, firms operating in a sector take unit (labour) costs of inputs from different countries as given to articulate a GVC. Thus, inter-country, inter-sectoral linkages of costs and technology may play a prominent role in explaining international economic performance. Therefore, to properly understand the components of productivity dynamics, it is necessary to shift the unit of analysis from the industry to the (inter-country) value chain.

It has been argued that the extent of GVC integration is positively related to labour productivity changes (Constantinescu et al., 2019). Hence, a setback for GVC integration might imply a slower pace of productivity growth for the world economy in the years to come, whereas a rewiring of input sourcing towards more expensive partners implies that productivity increases along the value chain will be needed to maintain competitiveness.

Against this background, by combining hypothetical extraction from a global perspective (Dietzenbacher et al., 2019) and vertical integration at an inter-country level (Timmer, 2017) this paper aims to: (1) refine productivity and competitiveness measurement at the value chain level, (2) using scenario analysis, rewire international productive linkages so as to reflect plausible geo-political reconfigurations of trade flows, and (3) quantify the potential effects of such rewiring on productivity and competitiveness across GVCs of the world economy.

Data to perform this scenario analysis will be sourced and articulated from the OECD's Inter-country Input-Output (ICIO), Trade in Employment (TiM) and Structural Analysis (STAN) databases, as well as the UNSD National Accounts main aggregates database.

In relation to aim (1), we will extend the analytical device of a vertically integrated sector (Pasinetti, 1973) to an inter-country setup (Timmer et al., 2013; Garbellini, 2014), measuring productivity along a value chain, which spans inputs sourced from different countries (cf. Timmer and Ye, 2020). But besides productivity, it will be necessary to vertically integrate (unit) labour costs, in order to arrive at a value-chain measure of competitiveness (cf. Marczak and Beissinger, 2022). Devising these measures will help to understand the contribution of trade partners to the productivity and unit labour costs of a country's GVC.

As regards aim (2), we will divide the world economy into three macro-areas: the global North, China and the (rest of the) global South. In line with strategies currently considered by geo-political debates, we will design possible reconfigurations of input linkages between regions. Using hypothetical extraction techniques (Dietzenbacher et al., 2019), we will compute the model-implied changes in the geographical and sectoral distribution of output, incomes and employment associated to alternative scenarios.

Finally, in relation to aim (3), we will apply the metrics derived in (1) to the scenarios formulated in (2) and quantify the potential implications for productivity and competitiveness across GVCs and for the world economy at large. In particular, we will also quantify the productivity adjustments required in each GVC to maintain actual levels of competitiveness.

The importance of this type of analysis cannot be understated. Strategic trade reconfigurations will impact productivity and global growth prospects. Hence, performing a preliminary assessment with the tools of global input-output analysis (see, e.g., Feenstra and Sasahara, 2018) will inform the debate on the potential effects of events currently taking place, but whose ultimate consequences may take years to emerge clearly.

ASSESSING THE IMPACTS OF WORKFORCE SKILL IMPROVEMENT ON INCOME TRANSFER PROGRAMME BENEFICIARIES IN BRAZIL

Topic:
Author: Rayan WOLF

This paper evaluates the economic impacts of workforce qualification through professional courses for beneficiary families of the Conditional Cash Transfer Program in Brazil using the DAYANE model, a computable, static, multiregional, and multisectoral general equilibrium model that divides Brazil into five macro-regions and families into ten income classes. It is developed in the GEMPACK language and disaggregates families' schooling into twelve different levels. Schooling improvement shocks were simulated for beneficiaries of the Bolsa Família Program.
As a result, income transfers to these families decreased in proportion to the increase in wages. The results show that labour qualification policies for beneficiaries improve their economic situation, with income transfers gradually being replaced by higher salaries, indicating that government transfers can be reduced in response to improved gains in the labour market.

How does the digital economy impact the manufacturing upgrading in the global value chain: Evidence of China

Topic: Trade and Global Value Chains Policies
Author: Kaiyao WU

(1) The research questions.
In the global value chain, the digital economy has reshaped the innovation pattern and the profit distribution model. It has also become a key factor for the country to expand GVC participation and improve its position in the GVC. There are many studies on this in academic circles (Kim J et al., 2019; Banga K, 2022). Wang et al. (2017a, b)'s study on GVC participation and position has been applied in more and more empirical studies. Zhou R et al. (2022) measure the digitization degree by the proportion of the added value of the ICT industry in the added value of manufacturing exports, and show that the digitization of China's manufacturing industry can increase the forward participation of GVC in the manufacturing industry. Zhang Y et al. (2022) measured the level of the digital economy by the added value input of the basic sectors of the digital economy into each manufacturing sector, characterized the upgrade characteristics of GVC from the dual dimensions of breadth and height, and empirically tested the impact of the digital economy on China's manufacturing industry.
Even though these studies provide revealing insights, simply using the added value of the basic sectors of the digital economy inputted in the manufacturing industry is not enough to reflect the full impact of the digital economy on the manufacturing industry. Therefore, it is powerless to study the comprehensive and structural impact of the digital economy on GVC participation and position. Also, it cannot explain the mechanism of this structural impact.
Our research in this paper aims to fill the above gap.
(2) The data used.
OECD national input output tables (IOTs)
OECD Inter-Country Input-Output (ICIO) Tables
OECD Trade in value-added (TiVA)
UIBE GVC Database
China Science and Technology Statistical Yearbook
China Industrial Statistical Yearbook
(3) The method used.
a. Based on the added value of the digital economy, this paper uses input-output analysis technology and follows the evolution path of the digital economy (OECD2009). It divides the digital economy into three components: infrastructure, integration, and diffusion. So that we measure the total size and individual components of the digital economy.
b. According to the participation-position GVC upgrading coordinate framework, analyze the possible impact directions and mechanisms of the digital economy as a whole and its components on GVC upgrading, and propose research hypotheses on the overall impact, component impact, and impact mechanism of the digital economy on GVC upgrading.
c. Use panel regression method to conduct rigorous verification of the above assumptions such as benchmark model, endogeneity test, robustness test and heterology analysis.
(4) The novelty of the research.
a. The whole effect and component effect of the digital economy's impact on industrial GVC upgrading are proposed and empirical tests are carried out.
b. The cost-saving effect and factor allocation effect of digital economy affecting industrial GVC upgrading are proposed and empirically tested.

Assessing the economic losses of destructive events: an analytical framework combining production and consumption perspectives

Topic: Disaster analysis
Author: Ran XU
Co-Authors: Xiang GAO

As global uncertainties persist, destructive events, whether natural or man-made, can cause disruptions to production and consumption, resulting in a significant impact on the overall economic system. This study proposes a comprehensive analytical framework to assess economic impacts of destructive events, utilizing the multi-regional input-output (MRIO) model and hypothesis extraction method. The advantage and contribution of our framework lies in its unique combination of production and household consumption perspectives. On the production side, our approach goes beyond traditional models by accounting for both upstream economic losses from production disruptions and downstream losses due to the interruption of intermediate product supply. This is achieved by integrating the concept of raw material inventory days on hand into the model. On the consumption side, our framework captures household spending loss due to the event by introducing the concept of non-rigid consumption, as well as long-term demand contraction generated by income loss, which is a novel approach in the field.
Employing the updated 2017 Chinese MRIO table, this framework was applied to conduct both retrospective and prospective analyses of destructive events. For retrospective analysis, we examined the economic impact of the COVID-19 outbreak in Shanghai in 2022. The estimated loss is about 153.8 billion yuan of gross domestic product (GDP) value in the second quarter of 2022 in Shanghai, with an error of only 3.6% compared to the actual data. This precise estimation underscores the reliability of our model in real-world scenarios.
The prospective analysis involved simulations to assess the potential impacts of similar events in various Chinese regions, enabling a comparative examination of economic characteristics across different areas. Furthermore, we explored the effectiveness of various disaster-mitigation policies through a series of what-if analyses, adjusting parameters and input variables within our model. This aspect of the research provided valuable insights into policy-making, highlighting how adjustments in strategies can effectively address challenges.
Overall, the results show that our analytical framework performs as a robust, accurate and flexible estimator for assessing the economic losses of destructive events under different scenarios. Additionally, it sheds light on the differentiated characteristics and roles of different regions in the economic system. This methodology is adaptable for analyzing global events like the Russia-Ukraine conflict and extreme weather impacts, providing valuable insights for risk management and policy-making.

Implementing the Just Energy Transition (JET) in Colombia: a prototype Ecological Input Output Stock Flow Consistent Model (E-IO-SFC)

Topic: Special Session - Assessing Industrial, Trade and Green Transition Policies Through SFC-IO Models
Author: Giuliano Toshiro YAJIMA

The energy transition is timely today for Colombia, not only because of the benefits it offers to its population, but also because the Colombian State has committed itself to promoting the decarbonization of the economy, and to mitigating the effects of climate change (MinAmbiente, República de Colombia, 2020). Decarbonizing the sectors that sustain the economy and adapting

energy systems has a direct implication on the use of energy sources, which are abundant in the Colombian territory.
In this sense, five pillars could be identified for a Just Energy Transition (JET): i) The transition must be carried out through the gradual replacement of fossil energy sources with renewable energy sources, guaranteeing the sovereignty and energy reliability and economic stability of the country, contributing to the mitigation of the effects of the climate crisis; ii) The energy transition shall contribute to the transformation of a mainly extractive economy into a truly productive economy, with renewable energies as one of its pillars; iii) This energy transition must allow the processes of adaptation of workers associated with the current mining and energy sector to the new productive economic structure; iv) Through the transition, energy equality (by means of energy accessibility and affordability) should be promoted; v) The use of the country's natural and renewable resources requires planning processes that promote their use in a sustainable way (Ministerio de minas y energía, República de Colombia, 2022).
This study aims to develop an ecological stock-flow consistent (SFC) model based on the case of Colombia. In particular, we build upon Nalin et al. (2023) analysis of a Latin American economy highly integrated into financial markets as we include a simplified Input-Output structure. Model parameters, initial values and technical coefficients are calibrated using empirical data from DANE (2023). We show how the model can replicate in-sample stylized facts for Colombia for the 1995-2023 period. We then provide an estimate of JET in accordance with i)-v) pillars.

A Supply Chain Network Analysis of Carbon Emissions from Textile and Apparel Sectors in China

Topic:
Author: Sota YAMAGUCHI
Co-Authors: Seiya IMADA, Shigemi KAGAWA

The apparel industry is responsible for 10% of the world’s carbon emissions, making it the second highest industrial polluter after the oil industry. Thus, Consequently, the global manufacturing industry, in its various forms, contributes to significant energy consumption and emissions, along with substantial amounts of carbon emissions.

This is due to the recent growth of fast fashion, which has led to mass production of clothing and an increase in textile waste. Clothing production has doubled since 2000, and with further spread of fast fashion, population growth, and economic development, the demand for apparel and textile products worldwide is expected to expand further, raising concerns about its impact on climate change.

Previous studies have evaluated the lifecycle impact of apparel consumption, emphasizing the importance and significance of reducing carbon emissions in this sector. However, these studies have not identified carbon emission hotspots within the global apparel supply chain. Addressing the crucial issue of greening global supply chain networks for specific carbon-intensive products, such as apparel, is imperative (see, for example, Kagawa et al., 2015).

Therefore, this research quantifies the global carbon footprint in China, the world’s largest consumer of apparel, and the contribution of each supply chain path transaction to carbon emissions. The novelty of this study is that it identifies carbon emission-intensive supply chain paths (i.e., CO2 emission hotspots) in the global apparel supply chain and provides concrete guidelines for stakeholders relevant to policy making to effectively reduce their carbon footprint.

Using the Global Multi-region Input-Output Model (Eora), we estimated the direct and indirect carbon emissions induced by final demand through standard Environment Extended Input-Output analysis (EEIOA). Furthermore, we applied Structural Path Analysis (SPA) to identify the supply chain paths with the largest contribution to domestic or foreign sector carbon emissions through China's textile and apparel sector, in other words, to pinpoint carbon emission hotspots.

The result shows that China's textile and apparel sector's final demand in 2015 contributed to approximately 400 million tons of carbon emissions, accounting for about 38% of the global carbon emissions from the apparel and textile sector. Moreover, domestic sectors accounted for about 93% of the carbon emissions attributed to China's textile and apparel sector. The supply chain paths with the largest carbon emissions were "Textiles and Wearing Apparel → Textiles and Wearing Apparel → Electricity, Gas, and Water" (13,716 kt-CO2e), "Textiles and Wearing Apparel → Petroleum, Chemical and Non-Metallic Mineral Products → Electricity, Gas, and Water" (9,923 kt-CO2e), and "Textile and Wearing Apparel → Textile and Wearing Apparel → Textile and Wearing Apparel" (9,919 kt-CO2e). The carbon emissions from each of these supply chain paths exceeded those emitted by the entire textile and wearing apparel sectors of Japan and the United Kingdom.

The empirical results indicate the importance of implementing appropriate measures in the Electricity, Gas, and Water sectors, as well as the Petroleum, Chemical and Non-Metallic Mineral Products sectors, involved in supply chain paths associated with China's Textile and Wearing Apparel to reduce carbon emissions. In addition, as Textile and Wearing Apparel is highly traded within the same sector, it is necessary to reduce the number of spillovers required to meet intermediate demand, i.e., to achieve factory consolidation.

This study identifies CO2 hotspots in China's textile and apparel supply chain. One of the key findings of this study is that addressing the supply chain paths caused by textile and wearing apparel in China has great potential to reduce CO2 emissions from the sector globally.

Harmonisation of National Accounts and Supply and Use Tables for the compilation of the OECD ICIO tables

Topic: Global Input-Output Accounts (GIANT): a collective initiative to harmonise input data entering ICIO tables published by international organisations (I)
Author: Norihiko YAMANO
Co-Authors: Colin WEBB

The OECD will present the work on the harmonisation of National Accounts and Supply and Use Tables carried out for the compilation of the OECD Inter-country Input-Output Tables.

Measuring the Multiple Layers of Greenhouse Gas Footprints in Global Production Networks: Emissions Embodied in Production Chains and Final Demand Patterns

Topic: Sustainable Production and Consumption Policies
Author: Norihiko YAMANO
Co-Authors: Michel LIOUSSIS

Input-Output Databases are useful tools that can be adapted to compare, evaluate and analyse carbon footprints of industries across countries. Their analytical power depending on the

coverage of countries and industries. These measures complement the existing estimates of territorial-based and production-based emissions from official statistics, allowing analysis of the interconnected structure of the global economy by considering all the chains of production until the final demand.

Building on the previous work comparing production-based and demand-based (consumption-based) measures of CO2 emissions, this study introduces new analytical indicators of GHG footprints based on global production network structures. Notably, GHG emissions embedded in domestic and international production networks; and, GHG emissions footprints associated with final demand patterns from purchasers' price perspectives. Using OECD's recently updated "Inter-Country Input-Output" (ICIO) database, the coverage of OECD's work on indicators related to greenhouse Gas (GHG) emissions embodied in international trade and final demand has recently been expanded to 76 countries (and the rest of the world) and the period of 1995 to 2020.

The new features include:
1) More use of emissions statistics compiled under the System of Environmental-Economic Accounting framework based on the resident principle. This allows calculation of production-based emissions that cover not only CO2 emissions from fuel combustion, but also non-fuel combustion emissions such as those from industrial processes and fugitive emissions from agricultural and mining activities.
2) The evaluation of the demand-based emissions by products from purchasers' perspectives. In fact, a common approach of carbon footprint studies has been to include emissions associated with distribution services accounting only for the intermediate transactions while this study explores the emissions from all intermediate, final consumption and capital formation expenditures.
3) The measure of the total direct and upstream emissions associated with production activities for both exported and domestic products.

These extended indicators create an opportunity to support policy decisions on decarbonisation of manufacturing processes, transitions towards renewable energy sources, and cross-border trade adjustments for high-carbon content products. They also provide new insights into the environmental impacts of the globalised world economy and, possible options for greenhouse gas mitigation to help governments design policies to reduce the ecological footprint.

The main data sources used for this analysis are OECD's ICIO database and GHG emissions statistics from Air Emissions Accounts (AEA) compiled by Eurostat and OECD. Going beyond analyses that only consider CO2 and energy consumption, and accounting also for non-fuel combustion emissions data for industries and households presents new methodological challenges, particularly related to filling gaps of missing data. The AEA GHG emissions statistics are only available for 42 countries with relatively weak coverage for earlier years (prior to the mid-2000s) for the majority of the covered economies and a considerable number of industries. These missing data are covered by adjusting information from other emissions data sources such as Fuel Combustion statistics and national inventories of GHG emissions.

The economies of many developing countries are dominated by agriculture and energy-related mining activities. In such cases, total GHG emissions are significantly higher than total CO2 emissions from fuel combustion activities. In developed economies, production-based emissions remain high for Electricity, Manufacture of basic metals and Household fuel combustion remain the highest activities of emission sources.

These changes in emissions production-based emissions result in both a smaller difference in the intensity of production-based emissions for developed countries and emerging economies compared to fuel combustion only indicators. When considering total GHG footprint indicators, we see an increase from 22 to 28 in the number of countries classified as net exporters of emissions when comparing with the same 66 target countries published in the 2021 edition of OECD's Trade in embodied CO2 database.

The direct and indirect emissions embodied in each product provides new insights of footprint measures from the viewpoints of purchasers and producers. The footprints of final expenditures of goods products become significantly higher than the emissions estimated by basic prices, as expected. The changes are evident for the sectors of products having important levels of trade and transport margins such as agriculture, food products and textile industries.

Trade without "proportionality": A novel approach to trace import uses

Topic: YSI and Development Programme V (Discussant: J. Rueda-Cantuche and B. Los)
Author: Fang YONGBIAO
Co-Authors: Pei JIANSUO, Jin ZHAOYANG

Import share is a key parameter in analysis of international trade. However, previous research mainly relies on the "proportionality" assumption (and its variants) to obtain share parameters, which may lead to biased estimates. In contrast, this paper introduces a novel approach that combines machine learning techniques with big data to accurately trace import uses within narrowly defined industries. We present a novel methodology to estimate the import matrix without "proportionality" assumption. To this end, based on Chinese customs product trade data, enterprise business registration data and rich micro-survey data, this study develops machine learning algorithms to precisely trace import uses. This approach is then applied to compile China's non-competitive input-output tables with 37 sectors during the period of 2000-2016. Essentially, our novel estimation approach overcomes the limitations of the "proportionality" assumption by utilizing rich micro datasets to identify the source sector and the use sector of each product. The procedure is as follows. Using customs trade data at product level, we first match it according to the concordance table between HS 8-digit code and the input-output sector to identify the source sector of the product. Then, we match it with the enterprise business registration database to identify the sector of the enterprise, which represents the use sector of the product. In this way, our estimation method directly traces the end-uses of imports rather than imposing "proportionality" assumption. Also, we compare the newly estimated import matrix with counterparts relying on the "proportionality" assumption. The comparison result shows that, overall, the differences in most import share estimates between the two methods are not significant. However, there are also some sectors with large differences in share estimates, exceeding 50 percentage points. We conclude by generalizing this methodology, which can be applied and adapted to other economies when tracing import uses, and serving as key inputs for analysis of international trade.

The Carbon Footprint of Religious Food Consumption

Topic: Sustainable Production and Consumption Policies
Author: Moyo YOSHIDA
Co-Authors: Shigemi KAGAWA, Waka NISHIFUJI, Haruka TODA

There has been a growing concern about effectively reducing CO2 emissions induced by a wide variety of household consumption activities, such as eating foods (Duchin, 1998). It is crucial to note that household consumption activities also significantly affected the carbon footprint of nations through the global supply chain (Hertwich and Peters, 2009). Duchin (2005) pointed out the importance of mitigating consumption-based CO2 emissions through lifestyle changes that reflect people's food purchases and dietary choices. Additionally, the previous study distinguished between rural and urban lifestyles.

Importantly, there are economic and cultural reasons behind food purchases and dietary choices, with religion being one of the influencing factors. A previous study found that consumers who believe in a specific religion tend to avoid gluttony but do not necessarily engage in sustainable food consumption (Minton et al., 2019).

To the best of our knowledge, there have been no previous studies focusing on the relationship between the carbon footprint and the religious preferences of nations. With this background, the novelty of this study is as follows. This study is the first attempt to investigate the influence of people's food consumption behavior, affected by their religious preferences, on CO_2 emissions throughout the supply chain. The study specifically focused on eight types of religions: Christians, Muslims, Hindus, Buddhists, Jews, Folk Religions, Other Religions, and the Unaffiliated.

The study utilized GROLIA database in 2018, a global multiregional input-output table that records inter-industry transactions and final consumption in 120 sectors across 164 countries worldwide, to gather data on food consumption in each country. The focus of this research was on the Asia-Oceania region, characterized by low religious diversity on a country-by-country basis, despite the overall high diversity of religious adherents in the region. We determined the amount of food consumption and the percentage of food consumption in each of the 15 food sectors per capita for each of the eight religious types in the Asia-Oceania region. Subsequently, we estimated the embodied CO_2 emissions in kg-CO2e per 1000 U.S. dollars of consumption in each food sector by believers of each religion in the Asia-Oceania region.

The results show that the embodied CO_2 emission intensities of consumptions among the eight religious types ranged between 538 kg-CO2e and 584 kg-CO2e per 1000 U.S. dollars. Muslims exhibited the highest emissions at 584 kg-CO2e per 1000 U.S. dollars, whereas Jews showed the lowest emissions at 538 kg-CO2e per 1000 U.S. dollars. Meat consumption among Jews accounted for a considerable 29.5% of the food-oriented CO_2 emission intensity, while dairy product consumption among Muslims and Hindus accounted for 24.8% and 41.2% of their respective emission intensities. In other words, this implies that countries with a Muslim majority and a Hindus majority consume a relatively larger amount of dairy products, such as milk and cheese, compared to other countries.

In conclusion, it is necessary to implement CO2 reduction policies focusing on food-oriented CO2 hotspots for each religion. Specifically, we suggest implementing an eco-labelling policy for targeted dairy products in both Muslim-majority and Hindu-majority regions, as well as a technology improvement policy to reduce direct CO2 emissions from processing dairy products.

Multinationals' technological transfer on right-sourcing strategies: an environmental assessment for the European Union

Topic: Special session: Environmental impact of global value chains reconfiguration
Author: Jorge E. ZAFRILLA
Co-Authors: Ángela GARCíA-ALAMINOS, Nuria GOMEZ, Mateo ORTIZ

[SPC] special sesion: Environmental impact of global value chains reconfiguration

Post-pandemic aspects and geopolitical context, combined with the climate emergency, are accelerating the restructuring of the global production chains. The European Union (EU) has been forced to react in recent years with clear examples that seek to improve the European Union's resilience in the international context through, for example, the Open Strategic Autonomy (Cagnin et al., 2021). This framework identifies technological, social, and environmental challenges as opportunities to encompass various policies to strengthen the EU's autonomy, resilience, and active role along global value chains. Multinational corporations must lead these international trade reconfiguration demands. Their influence along global production chains and ability to move investment flows internationally will be key in addressing the new economic, technological, and environmental challenges derived from these reshaping trends.
This paper aims to quantify the environmental impact of the target sectors' reshoring emerging trends of the EU's multinational operating abroad. To do so, first, we will propose a relocation proposal that will shorten global production chains, allocating the EU's multinational production in foreign countries among new EU and near-friends host countries. Second, to fulfill the EU's environmental goals, we will evaluate the impacts of technology transfers from parent companies to subsidiaries in environmental terms.
The methodological approach for the relocation process will be based on a source-shifting proposal (de Boer et al., 2019; Giammetti, 2020; Gilles et al., 2021) using an environmentally extended MRIO model based on the ICIO-AMNE database, which presents a depiction of the activities of multinational enterprises combined with the ICIO tables (Cadestin et al., 2018). The shifting proposal of EU multinationals' activity back to Europe will be based on the search for comparative advantages in labor costs under the EU-27 average. Once the relocation is solved and evaluated in environmental terms, the technological transfers will occur if the foreign multinational hosting sector's emissions multiplier is dirtier than the parent company country's domestic sector. The proposal is to substitute the emissions coefficient vectors to improve the environmental performance of the multinationals operating within the EU (Duan and Jiang, 2021; Steenbergen and Saurav, 2023; Wiebe, 2018).
Given the recent contributions of Dachs et al. (2019), Eurofound (2019), and García-Alaminos (2023), the growing reshoring trends show some patterns: 1) It is concentrated in medium to high-tech industries and larger firms; 2) Manufacturing sectors presents higher propensities to reshore; 3) There is a need for firms to react fast and flexible to changing conditions. Given these patterns, multinational corporations fit the production profile to relocate globally. The sectors we will relocate will be Basic Metals, Computer, electronic and optical products, and Electrical equipment. All of them strategic sectors fro the energy transition in the EU.
Preliminary results for the case of the Electrical equipment sector show a global emissions reduction by -17 MtCO2, representing a -0.06% of global emissions and -0.7% of the EU producer footprint. However, within the EU borders, an emissions increase is expected to occur of 4.78 MtCO2 in the main new hosting countries. Beyond the EU, the producer footprint reduction is estimated at -22.14 MtCO2, occurring mainly in the former main suppliers' countries. This study will allow us to evaluate the sectoral incidence of emissions increases within the EU. For this first bulk of results, Poland's emissions increase accounts for -1.7 MtCO2, the highest producer-based increase within the EU. By sector, emissions are concentrated in the electricity and gas sectors

for both domestic and foreign multinational firms. In a forthcoming round of results in this paper, we will evaluate the emissions reduction expected if the technological transfer from parent companies occurs.
Regarding the policy recommendations, and given these preliminary results, we can say that a global restructuring of production in terms of production structures generates small emissions reductions. On the contrary, technological transfer in terms of changes in emission coefficients can significantly reduce the environmental impact of the reallocation trends within the EU. Then, policy recommendations will be oriented to reinforce the Energy Transition among all EU countries to ensure emissions reductions. The decarbonization of energy sectors is mandatory within the EU borders. Moreover, from EU companies' perspective, shorter global value chains (or regional value chains) allow for the relocation of energy-intensive stages in countries with lower-carbon energy mixes to reduce their carbon footprint.

How Does Technology Improve the Role of Financial Sector in Economy? An Empirical Analysis of Global Banks Based on Input-Output Model and Knowledge Graph

Topic: Financial analysis
Author: chuhan ZHANG
Co-Authors: Jichang DONG, Xiaoyue XU, Xiuting LI

The core mission of the modern financial industry is to support the high-quality development of the real economy, and technology, as the primary productivity, is considered a pivotal means to empower the quality and efficiency of financial services to the real economy. However, research on the core issue of how technology can better play this empowering role is limited, with related practices still in the exploratory stage and effective solutions yet to be sufficiently developed. Thus, there is an urgent need for further deepening of relevant theories and empirical research to provide the necessary theoretical guidance and decision support for the practice of technological innovation and business development within the financial industry.
This study innovatively approaches the issue by examining how technology empowers financial services to support the real economy from the perspective of matching technology supply with business demand. We propose a method to measure the impact of financial services on the real economy using input-output models, alongside a novel approach to measure the degree of matching between supply and demand side based on knowledge graph. Using the banking industry as a case study, we empirically test the impact of technology supply-demand matching on the efficacy of financial services to the real economy, analyzing the optimal level of matching necessary to leverage technology effectively in empowering financial services.
Specifically, drawing on OECD's national input-output tables spanning from 2000 to 2020, we employ input-output analysis to calculate indicators such as the pulling and sensitivity of the banking sector, providing a comprehensive measure of commercial banks' role in the economy. Additionally, a knowledge graph network linking global banking business with technology is constructed, using over 152,000 entries of English patent texts in the global banking industry. Employing network analysis methods, the study derives the "degree of technology supply-business demand matching" indicator for banks. We further investigate the mechanism using econometric models, through which technological innovation affects the efficiency of bank services to the real economy with the moderating effect of matching index.
Our findings reveal insights as follows: First, the effect of global banks on various sectors of the economy is higher in middle to high-income countries than other groups with a continuous increasing trend in the past eight years. Second, in terms of the degree of technology supply and business demand matching, developed countries exhibit "deep penetration" while developing

countries explore through "comprehensive development", with both earned advantages in areas such as credit assessment and mobile payment. Third, the positive impact of matching between technology and business on the efficiency of bank services to the real economy is significant, while the indicator has an optimal level and also an asymmetric moderating effect on this impact. The main contributions of our study are: First, it is to our knowledge the first study to measure the quality of technological innovation and its impacts from the view of technology supply-business demand matching, which is an expansion of relevant theories on technology economics and bank management. Second, methodologically, we propose a novel method to measure the supply-demand matching based on knowledge graph, combining unstructured text processing of bank patents and semantic network modeling methods to construct a fine-grained banking network. This work also expands the application field of input-output analysis methods, providing foundational data framework and methodological reference for relevant research. Third, this study has prominent practical guiding value. The research conclusions can effectively guide banks and other financial institutions to optimize the allocation of technological resources oriented towards demand, enhance financial technology competitiveness, and empower the quality and efficiency of financial services to the real economy.

China’s emissions embodied in trade: How regional and firm size heterogeneity matter

Topic:
Author: Junrong ZHANG

The rapid growth of China’s foreign trade (international trade) and interregional trade (domestic trade) has increased the pressure on carbon emission reduction and the disparity among regions. It also makes an urgent request to coordinate regional trade development and carbon emission reduction. Small and medium-sized enterprises (SMEs) are the underlying executive bodies of domestic and international trade, and their distribution is significantly imbalanced across regions. However, existing studies ignored the heterogeneity among different firm size categories, which may distort trade embodied carbon emissions across regions. Given this, this study constructs a new interregional input-output model that captures both China’s regional heterogeneity and firm size heterogeneity (IRIO_LMS) for eight regions in the years 2007, 2012, and 2017. Based on the novel model, we develop a “multi-level” method to analyze the characteristics and flows of trade embodied carbon emissions by firm size categories and regions. Therefore, the IRIO_LMS model gives more accurate accounting on the regional environmental loss due to foreign trade and interregional trade and thus is important for establishing effective emission mitigation policies.

Economic Consequences of a Potential High-Intensity Cross-Strait Conflict: A Supply Chain Analysis Using the Hypothesis Extraction Method

Topic:
Author: Meichen ZHANG
Co-Authors: Ming YE, Bo MENG, Zhi WANG

This paper analyzes the economic consequences of a potential high-intensity conflict between mainland China and Taiwan across the Taiwan Strait. We use the newly developed Greater China Inter-Regional Input-Output Tables, which provide detailed information on firm ownership for mainland China at the provincial level and also cover the economies of Hong Kong, Macau, and

Taiwan for 42 sectors. This data allows us to devise a systematic analysis framework and apply the revised Hypothesis Extraction Method to simulate the economic effects of the conflict from a supply chain perspective. Unlike traditional models, our approach also accounts for the firm's response under external shocks and considers various hypothetical scenarios. We analyze three scenarios: (1) Disruption of trade between mainland China and Taiwan, involving both intermediate and final goods in the short run; (2) Interruption of production capacity of Taiwan-owned firms in mainland China in the short run; (3) Replacement of Taiwan-owned firms by mainland China-owned firms, indicating value chain restructuring in the medium or long run. Our results indicate that: (1) Complete trade disruption and production capacity interruption of Taiwan-owned firms could result in about 0.35% and 1.76% GDP loss, respectively; (2) Replacing Taiwan-owned firms in mainland provinces with mainland China-owned firms in the medium or long run could reduce GDP losses, with an extension ratio ranging from 25% to 100%, the GDP loss could decline from 1.3% to 0.83%. (3) A full trade disruption between mainland China and Taiwan could make mainland China-owned firms bear 83% of the total GDP loss; (4) Provinces located in coastal areas or with a high concentration of Taiwan-funded enterprises are likely to face the most severe impacts; (5) The electronic equipment and chemical manufacturing industries are vital to the cross-strait supply chain, they account for 5.48% and 1.76% of the GDP losses in mainland China, and contribute to 25.82% and 46.01% of the total losses for Taiwan, respectively. Our study gives us some useful insights for developing global supply chain strategies and evaluating preparedness, recovery, and reconstruction plans, in case there is a risk of disruptions caused by this or similar future events. We hope that our study can help the policymakers, the businesses, and the public to understand the potential economic consequences of the geopolitical conflicts and to avoid or minimize the negative impacts.

The Network Structure of the "Belt and Road" Value Chains: Considering Transnational and China's Inter-Provincial Input-Output Linkages

Topic:
Author: Meichen ZHANG
Co-Authors: Yuning GAO, Bo MENG

The Belt and Road Initiative (BRI), a large-scale international cooperation effort, aims to foster deeper regional integration and extend global value chains (GVCs). With rapid development, over 140 countries and regions have joined this initiative. In order to provide better understanding of the nature and structure change of BRI value chains, various Multi-Regional Input-Output (MRIO) analyses have been conducted. However, the existing MRIO based studies lack clear visualizations of the increasing complexity of BRI's value chains. Additionally, they often overlook the impact of country size in measuring production networks. For example, China, as the largest developing country with 31 provinces, in which some of these provinces have already surpassed the economic size of more than half of BRI countries in average and now hold key positions in GVCs due to China's rapid domestic infrastructure development and provincial level policy supporting. Consequently, it becomes crucial to treat Chinese provinces as distinct entities and explore their roles and relationships with other BRI countries through both international and domestic-inter-provincial production linkages.
To analyze the spatiotemporal patterns and network evolution of BRI value chains, this paper pioneers the integration of annual Chinese inter-provincial input-output tables (covering 17 sectors and 30 provinces) into the global MRIO tables (specifically, the ADB MRIO tables) for the years from 2007 to 2021 using the double proportional scale method (RAS method). This newly extended MRIO dataset enables us to establish a systematic analytical framework and apply

topological network analysis to reveal the intricate nature of BRI value chains.
Our research findings reveal the following key points:
1) Increased Network Density: Since the inception of the BRI Initiative, there has been a significant rise in network connections between domestic provinces and BRI economies.
2) Central Role of Guangdong and Zhejiang: Guangdong and Zhejiang provinces now occupy central positions within the BRI value chains. Their roles are comparable to those of developed countries like Italy, South Korea, and Russia.
3) Evolution of the European Region: The European region has transitioned from a single-centered network, primarily led by Italy, to a multi-centered network. Provinces such as Yunnan, Chongqing, and Shaanxi have emerged as crucial intermediary hubs, facilitating connections between the East Asian region and China within the BRI value chains.
4) Supply and Demand Hubs: Guangdong province remains the largest supply and demand hub in the electronics manufacturing industry's division of labor network in the BRI value chains. Simultaneously, Chongqing city has risen as a new supply center, while Shanghai has advanced to become the second major core hub in the service industry network within BRI value chains.
Additionally, we conducted an analysis of the impact of international tariffs and both international and domestic non-tariff barriers, on the BRI value chains. Using a transnational and inter-provincial Gravity model, we found that the construction of China's unified large market contributes to eliminating domestic transaction costs among provinces, thus significantly promote stronger connections not only between Chinese provinces and BRI countries, but also even the increasing connection across BRI counties via spillover effects.
Our work establishes a robust foundation for diverse innovative research based on input-output analysis and econometric causal studies, taking into account the heterogeneity of domestic-subnational information in the existing country level MRIO frameworks.

Pension insurance reform, factor income distribution and savings rate: an experience from China

Topic: Price and Income Policies
Author: Mingwei ZHANG
Co-Authors: Xiuting LI

Abstract: Background: The downward pressure on today's world economy is huge. Expanding domestic demand, boosting consumption and promoting rational savings are of great significance to driving economic recovery. Since the 1970s, China's national savings rate has been among the top in the world. The imperfect social pension security system and unequal distribution of factor income are considered to be closely related to China's high savings rate (Meng L G, 2019; Wang H J and Chen X K, 2011). According to some studies, the pension security system has a "crowding out" effect on the savings rate (Yang L X, 2020) and also has an income redistribution effect (Sosa, 2021). Guo(2011) discussed the impact of taxation as a means of income redistribution on the structure of factor income distribution and believed that different types of taxation separately affected the factor income of labor and capital. However, few researches have studied the impact of perfecting the pension insurance system on the resident savings rate from the perspective of improving the inequality of factor income distribution.
In 2009, China experimented with the "New Rural Social Endowment Insurance" in 22 provinces, covering 10% of the counties and cities, which changed the pension insurance paid by individual farmers to the pension insurance jointly paid by individuals, collectives and governments.

Question: Based on the quasi-natural experiment of " New Rural Social Endowment Insurance " pilot, this paper explores how the improvement of social pension security system affects the

macro savings rate. Does it change the distribution structure of factor income? Does factor income distribution affect saving rate? What is the mechanism? Is there heterogeneity in different regions?

Methods: Data of input-output tables from 2007-2012 of 31 provinces in China are used to calculate the savings rate, labor factor income distribution and rural income distribution of the provinces before and after the " New Rural Social Endowment Insurance" pilot. Since the " New Rural Social Endowment Insurance" involves 22 provinces, it is difficult to match the experimental group and control group with traditional DID model. Therefore, the proportion of pilot counties and cities in each province is adopted as the policy variable, and the continuous multiple-difference model is used to explore the impact of the improvement of social pension insurance system on the macro savings rate and its mechanism.

Conclusion: The results show that (1) the implementation of New Rural Social Endowment Insurance significantly reduces the macro savings rate. (2) In terms of mechanism, New Rural Social Endowment Insurance affects the savings rate by increasing the channels of rural income distribution and labor factor income distribution. (3) Further analysis shows that the effect of New Rural Social Endowment Insurance on saving behavior is weaker in more economically developed areas and stronger in areas with lower fertility rate.

Novelty: (1) Most of the existing studies have used micro household data to measure the impact of pension insurance on savings rate, but this paper provides macro-level evidence. (2) Innovatively explore the mechanism of pension security system's impact on savings rate from the perspective of factor income distribution. (3) Using the ratio of counties and cities as the degree of policy impact, a continuous multiple-difference model is constructed.

Key words: endowment insurance; input-output analysis; factor income distribution; saving rate;

Impact of India Undertaking China's Industry Relocation on China

Topic:
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Under the influence of various factors such as politics, economics, and technology, global value chains are undergoing profound adjustments. Western countries and India itself are actively enacting a series of industrial policies aimed at positioning India as a focal point for the new phase of international industry relocation. has triggered profound changes in industrial layout, ultimately impacting the Chinese economy and employment. This paper begins by employing a national input-output model, utilizing a quantitative assessment framework for the recipient of industrial transfer, and identifying the advantageous industries that India may undertake based on industry gradient coefficients. Subsequently, the paper employs a trade gravity model to characterize the extent to which India is undertaking China's outward transfer. Finally, by distinguishing between intermediate and final goods and employing scenario analysis and counterfactual analysis, the paper measures the potential impact of India undertaking China's outward industrial transfer on the Chinese economy and employment.

How does Chinese provinces participate in the global production networks?

Topic:
Author: Yibing ZHANG
Co-Authors: Chen PAN, Shantong LI, Jianwu HE

China has a large territory and provinces with different resource endowments and development foundations. When exploring the economic characteristics of China, it is essential not only to conduct a nationwide analysis but also to delve into a provincial-level examination. This paper, adopting the most up-to-date inter-country input-output table embedded with Chinese provinces of the year 2017, breaks down the participation of Chinese provinces in the global production networks into four components following the value-added decomposition method: the non-trade value-added, value-added in the traditional trade, value-added in the simple value chains, and those in the complex value chains. Based on the decomposition, the primary modes of the provinces' participation and pathways in the global production networks are investigated.
The results show that Chinese regions are highly involved in value chain activities, with smaller shares of non-trade value-added compared to other economies, especially the provinces with stronger industrial base and more developed productive service sectors, showing a more pronounced role in value chain activities. The complex value chain activities tend to be more domestically and regionally, with domestic activities having greater impacts on provincial economies than the foreign ones. The European Union, the United States, and the ASEAN are the key "organizers" for Chinese provinces' participation in the global value chains, while Guangdong and provinces at the Yangtze River Delta play crucial roles in "organizing" provinces' participation in the domestic value chains. In addition, the construction sector drives the regional economies mainly via the non-trade pathways. The labor-intensive and technology-intensive sectors are dominant in the traditional trade, while the capital-intensive sectors are the key drivers in both the simple and complex value chains.

Heterogeneous impacts of dietary transition in China on planetary boundaries

Topic: Sustainable Production and Consumption Policies
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Population ageing in China is reshaping the food system and associated environmental impacts via global supply chains, yet the expected pressure on the proposed planetary boundaries and the possible environmental consequences of dietary changes are still unknown. Here we adopt a quadratic almost ideal demand system (QUAIDS) model and the EXIOBASE database to estimate China's food-related environmental footprints (greenhouse gas emissions, eutrophication and cropland use) across age groups from 2020 to 2060, based on population projections aligned with the Shared Socioeconomic Pathway 2 (SSP2). Considering the nation's ongoing population ageing, we found its total food-related environmental footprints will continue to increase and reach a peak around the year 2050. This temporal trend is primarily driven by the rising purchase power of young adults (20-59 years) and increasing elderly populations (60+ years). Under the business-as-usual scenario, the projected environmental impacts would exceed China's local safe boundary for phosphorus flows and land-system change by nearly half. Due to environmental spillover effects, the regional-level planetary boundary of China's trading partners would also be highly occupied, particularly European countries (Netherlands, Ireland, Germany, and Spain) and

South American countries (Brazil and the rest of America). Moving China’s current trend-oriented food choices to healthy dietary patterns could alleviate 0%–8% possible pressure on the planetary-level safe boundary. Regionally, compared to the reference diet, the dietary transition could ease environmental pressure, especially for South American countries (reduction of 0%–7%) due to the reduced red meat consumption, and concurrently put additional pressure, especially for European countries (growth of 2-45%) because of increased dairy consumption. The study reveals that targeted dietary changes in China would not be enough to globally mitigate the expected environmental pressure on the food system sustainability.

Charting China's Energy Transition: Constructing and Analyzing a Time Series of Energy Use between 1997 and 2021

Topic:
Author: Lingxiu ZHU
Co-Authors: Erik DIETZENBACHER, Cuihong YANG

Energy transition involves the shift from fossil fuels to renewable and sustainable alternatives. Although annual data on energy use for China exist, they show certain shortcomings. For example, there exists an overestimation in the reported "total energy consumption by sector" in the China Energy Statistical Yearbook. A primary contribution of this paper is therefore the construction of a time series of China’s sectoral energy use matrix from 1997 to 2021. The data addresses the overestimation issue and provides information on China’s yearly energy use by 47 sectors (including 46 industries and households) as well as 30 energy products. Our applications of the new data are twofold. First, we examine through a shift-share analysis the changes in China’s energy use patterns across different sectors, and preference for energy products. Second, we introduce an energy transition index to quantify China's progress towards sustainable energy systems. This research contributes to advancing our understanding of China's energy transition process. It may assist strategic decision-making to accelerate the transition towards a sustainable energy future.

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MELICIANI, VALENTINA	UNIVERSITY LUISS GUIDO CARLI, ITALY	
MENEZES, GABRIELITO	UNIVERSIDADE FEDERAL DE PELOTAS (UFPEL), BRAZIL	
MENG, BO	IDE-JETRO, JAPAN	
MERCATANTE, JUAN	PARIS SCHOOL OF ECONOMICS AND THE UNIVERSITY OF BUENOS AIRES, ARGENTINA	Parallel Session 2, Z-407
MERCIAI, STEFANO	2.-0 LCA CONSULTANTS, DENMARK	
MEVEL, SIMON	UNITED NATIONS ECONOMIC COMMISSION FOR AFRICA, ETHIOPIA	Parallel Session 7, Enrique Iglesias
MI, ANRAN	UNIVERSITY OF CHINESE ACADEMY OF SCIENCES, CHINA	Parallel Session 7, Z-407
MICHELENA, GABRIEL NICOLAS	MESI, UBA, ARGENTINA	
MIGUEZ, THIAGO	BRAZILIAN DEVELOPMENT BANK (BNDES), BRAZIL	Parallel Session 9, Medina
MIROUDOT, SEBASTIEN	OECD, FRANCE	
MIROUDOT, SEBASTIEN	OECD, FRANCE	
MITOMA, HARUKA	KYUSHU UNIVERSITY GRADUATE SCHOOL OF ECONOMICS, JAPAN	Parallel Session 4, Fernando Fajnzylber
MORALES, JESÚS	UNIVERSIDAD SERGIO ARBOLEDA, COLOMBIA	
MORENO-REYES, EDUARDO	UNIVERSITÀ DEGLI STUDI DI MACERATA, ITALY	Parallel Session 8, Aula I
MORLIN, GUILHERME	UNIVERSITY OF PISA, ITALY	Parallel Session 7, The Executive Room
MOTOSHITA, MASAHARU	NATIONAL INSTITUTE OF ADVANCED INDUSTRIAL SCIENCE AND TECHNOLOGY, JAPAN	Parallel Session 2, Medina

FULL NAME	INSTITUTION, COUNTRY	CONFERENCE PRESENCE
MUKHOPADHYAY, KAKALI	MCGILL UNIVERSITY, CANADA	Parallel Session 8, Z-407 Parallel Session 9, Z-407
NAGASHIMA, FUMIYA	KINDAI UNIVERSITY, JAPAN	Parallel Session 4, The Executive Room
NAGATA, AI	KYUSHU UNIVERSITY, JAPAN	Parallel Session 6, Aula I
NAKAISHI, TOMOAKI	KYUSHU UNIVERSITY, JAPAN	
NANSAI, KEISUKE	NAT. INST. FOR ENV. STUDIES (NIES), JAPAN	
NAZARETH, MARCOS	UNIVIÇOSA, BRAZIL	
NECHIFOR, VICTOR	EUROPEAN COMMISSION JOINT RESEARCH CENTRE, SEVILLE, SPAIN	
NISHIFUJI, WAKA	KYUSHU UNIVERSITY, JAPAN	
NOTTEN, TOM	CENTRAAL BUREAU VOOR DE STATISTIEK, NETHERLANDS	
OGA, YUSUKE	KYUSHU UNIVERSITY, JAPAN	
OGA, YUSUKE	KYUSHU UNIVERSITY, JAPAN	Parallel Session 1, The Executive Room
OJEDA, MARIA	INTERDISCIPLINARY INSTITUTE OF POLITICAL ECONOMY (UBA-CONICET), ARGENTINA	Parallel Session 1, Aula I
OKUYAMA, YASUHIDE	UNIVERSITY OF KITAKYUSHU, JAPAN	Parallel Session 1, Z-407
OLDFIELD, JON	UNIVERSITY OF BIRMINGHAM, UNITED KINGDOM	
OLIVEIRA, CASSIUS	UNIVERSIDADE FEDERAL DO RIO GRANDE FURG, BRAZIL	Parallel Session 2, Medina
ORO, GIANMARCO	UNIVERSITY OF FLORENCE, ITALY	
OROZCO-MORALES, ROBERTO	ECLAC-UN, MEXICO	Parallel Session 5, Enrique Iglesias
ORTIZ, MATEO	UNIVERSIDAD DE CASTILLA-LA MANCHA, SPAIN	Parallel Session 2, Fernando Fajnzylber
OSEI-OWUSU, ALBERT	AALBORG UNIVERSITY, DENMARK	Parallel Session 4, Medina
PADILLA PEREZ, RAMON	COMISIÓN ECONÓMICA PARA AMÉRICA LATINA Y EL CARIBE (CEPAL)H, MEXICO	
PAL, BARUN	INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE, INDIA	
PAN, CHEN	INSTITUTE OF QUANTITATIVE & TECHNOLOGICAL ECONOMICS, CHINESE ACADEMY OF SOCIAL SCIENCES, CHINA	
PANICCIA', RENATO	IRPET (REGIONAL INSTITUTE OF ECONOMIC PLANNING OF TUSCANY), ITALY	
PASSONI, PATIEENE	UNIVERSIDADE FEDERAL DO RIO DE JANEIRO, BRAZIL	Parallel Session 2, Enrique Iglesias
PAUW, KARL	IFPRI, UNITED STATES	
PAZIENZA, MARIA GRAZIA	UNIVERSITY OF FLORENCE, ITALY	
PEDAUGA, LUIS	EUROPEAN COMMISSION, SPAIN	
PENA-BOQUETE, YOLANDA	AYECONOMICS RESEARCH CENTRE, SPAIN	Parallel Session 2, Fernando Fajnzylber
PEREIRA, ROBERTO	SEPLAN - SECRETARIA DO PLANEJAMENTO DO ESTADO DA BAHIA, BRAZIL	
PEREIRA, XESÚS	UNIVERSIDADE SANTIAGO DE COMPOSTELA, SPAIN	
PEROBELLI, FERNANDO	FEDERAL UNIVERSITY OF JUIZ DE FORA, BRAZIL	
PESSANHA, GABRIEL	UFRJ/IE/PPGE, BRAZIL	Parallel Session 2, The Executive Room
PFISTER, STEPHAN	ETH, SWITZERLAND	
PIERROS, CHRISTOS	LABOUR INSTITUTE GENERAL CONFEDERATION OF GREEK WORKERS INE GSEE, GREECE	
PINACHO, RUTH	UNIVERSIDAD DE VALLADOLID, SPAIN	
PINERO, PABLO	JRC, EUROPEAN COMMISSION, SPAIN	Parallel Session 2, Enrique Iglesias
PINTO, KETHELYN	UFRJ, BRAZIL	Parallel Session 6, Enrique Iglesias
PINTO, RICARDO	MARETEC, LARSYS, INSTITUTO SUPERIOR TÉCNICO, UNIVERSIDADE DE LISBOA, PORTUGAL	
PLASSENBERG, JAN	INSTITUTE OF ECONOMIC STRUCTURES RESEARCH, GERMANY	Parallel Session 6, Fernando Fajnzylber
PRABHU, VISHNU	GOKHALE INSTITUTE OF POLITICS AND ECONOMICS, INDIA	Parallel Session 2, Z-407
PRATT, STEPHEN	UNIVERSITY OF CENTRAL FLORIDA, UNITED STATES	
PRETAROLI, ROSITA	UNIVERSITY OF MACERATA, ITALY	
RAMAEKERS, PASCAL	STATISTICS NETHERLANDS, NETHERLANDS	

FULL NAME	INSTITUTION, COUNTRY	CONFERENCE PRESENCE
RAMOS, MARIA PRISCILA	INSTITUTO INTERDISCIPLINARIO DE ECONOMÍA POLÍTICA (IIEP), UNIVERSIDAD DE BUENOS AIRES (UBA), CONICET., ARGENTINA	
RAMOS, MARIA PRISCILA	INSTITUTO INTERDISCIPLINARIO DE ECONOMÍA POLÍTICA (IIEP), UNIVERSIDAD DE BUENOS AIRES (UBA), CONICET., ARGENTINA	Parallel Session 9, The Executive Room
RIBEIRO, CAROLINA	UNIVERSIDADE FEDERAL DO DELTA DO PARNAÍBA - UFDPAR, BRAZIL	Parallel Session 9, The Executive Room
RIBEIRO, LUIZ CARLOS DE	FEDERAL UNIVERSITY OF SERGIPE, BRAZIL	Parallel Session 1, The Executive Room
RINALDI, LORENZO	POLITECNICO DI MILANO, ITALY	Parallel Session 5, Fernando Fajnzylber
ROCCHI, BENEDETTO	UNIVERSITY OF FLORENCE, ITALY	Parallel Session 4, The Executive Room Parallel Session 4, The Executive Room
ROCCO, MATTEO	POLITECNICO DI MILANO, ITALY	Parallel Session 6, Fernando Fajnzylber
ROCHA, FILIPE	FEDERAL UNIVERSITY OF JUIZ DE FORA, BRAZIL	
RODOUSAKIS, NIKOLAOS	CENTRE OF PLANNING AND ECONOMIC RESEARCH, GREECE	Parallel Session 8, The Executive Room
ROGNINI, DAVIDE	UNIVERSIDAD PONTIFICIA COMILLAS, SPAIN	
ROITBARG, HERNAN	IHUCSO (UNL-CONICET), ARGENTINA	Parallel Session 5, Enrique Iglesias
ROKICKI, BARTLOMIEJ	UNIVERSITY OF WARSAW, POLAND	
ROMÁN, MARIA	EC JRC, SPAIN	
ROMERO, CARLOS	UBA, ARGENTINA	
ROMERO GÓMEZ, EXEQUIEL	INSTITUTO INTERDISCIPLINARIO DE ECONOMÍA POLÍTICA, UNIVERSIDAD DE BUENOS AIRES & CONICET, ARGENTINA	Parallel Session 5, The Executive Room
RUEDA-CANTUCHE, JOSÉ M.	EUROPEAN COMMISSION, SPAIN	Parallel Session 4, Fernando Fajnzylber Parallel Session 7, Fernando Fajnzylber Parallel Session 8, Fernando Fajnzylber
RUIZ NAPOLES, PABLO	UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO, MEXICO	
SAHOO, AMARENDRA	JOINT RESEARCH CENTRE OF EUROPEAN COMMISSION, SPAIN	Parallel Session 7, Aula I
SALGUEIRO, GUILHERME	FEDERAL UNIVERSITY OF MINAS GERAIS, BRAZIL	
SÁNCHEZ, MARINA	UNIVERSIDAD DE CASTILLA LA MANCHA, SPAIN	Parallel Session 9, Aula I
SÁNCHEZ CHÓEZ, NAPOLEÓN	ESCUELA POLITÉCNICA NACIONAL, ECUADOR	
SANCHEZ RODELGO, ALBERTO	IMF, UNITED STATES	
SANGUINET, EDUARDO	PONTIFICIA UNIVERSIDADE CATÓLICA DO RIO GRANDE DO SUL, BRAZIL	Parallel Session 1, The Executive Room
SANTOS, MARIA	FUNDAÇÃO JOÃO PINHEIRO, BRAZIL	
SANTOS, SUSANA	UECE (RESEARCH UNIT ON COMPLEXITY AND ECONOMICS) - REM (RESEARCH IN ECONOMICS AND MATHEMATICS). ISEG - LISBON SCHOOL OF ECONOMICS AND MANAGEMENT, UNIVERSIDADE DE LISBOA, PORTUGAL	Parallel Session 9, Enrique Iglesias
SAVONA, MARIA	UNIVERSITY OF SUSSEX, UNITED KINGDOM	
SCHMIDT, JANNICK	2.-0 LCA, DENMARK	
SCHOER, KARL	SUSTAINABLE SOLUTIONS GERMANY - CONSULTANTS GMBH, GERMANY	
SESSO FILHO, UMBERTO	UNIVERSIDADE ESTADUAL DE LONDRINA, BRAZIL	
SEVERINI, FRANCESCA	UNIVERSITY OF MACERATA, ITALY	Parallel Session 8, Medina
SHAN, YULI	UNIVERSITY OF BIRMINGHAM, UNITED KINGDOM	
SHARMA, AKHILESH	INDIA	
SHIMOTSUURA, TAIGA	KYUSHU UNIVERSITY, JAPAN	Parallel Session 6, Medina
SHIYUN, ZHANG	BEIJING RESEARCH CENTRE FOR SCIENCE OF SCIENCE, CHINA	

FULL NAME	INSTITUTION, COUNTRY	CONFERENCE PRESENCE
SHODA, TOMOMI	KYUSHU UNIVERSITY, JAPAN	Parallel Session 5, Z-407
SHUKLA, SANJANA	INDIAN COUNCIL FOR RESEARCH ON INTERNATIONAL ECONOMIC RELATIONS, INDIA	
SILVA, CLÁUDIO EURICO	UNIVERSIDADE FEDERAL DE RONDONÓPOLIS, BRAZIL	Parallel Session 9, Aula I
SIMÕES, CAROLINA	UNIVERSIDADE FEDERAL DO RIO GRANDE, BRAZIL	
SOARES, SERGIO	NATIONAL WATER AND SANITATION AGENCY - ANA, BRAZIL	
SOCCI, CLAUDIO	UNIVERSITY OF MACERATA, ITALY	
SOKLIS, GEORGE	PANTEION UNIVERSITY OF SOCIAL AND POLITICAL SCIENCES, GREECE	
SONG, XUGUANG	SCHOOL OF STATISTICS, BEIJING NORMAL UNIVERSITY, CHINA	
SOUSA, TÂNIA	LISBON UNIVERSITY, PORTUGAL	
SOUSA FILHO, JOSÉ	STATE UNIVERSITY OF FEIRA DE SANTANA, BRAZIL	
SOUSA FILHO, JOSÉ FIRMINO DE	STATE UNIVERSITY OF FEIRA DE SANTANA, BRAZIL	Parallel Session 4, Aula I
SOUZA, CARLA	FUNDAÇÃO JOÃO PINHEIRO, BRAZIL	
SPINOLA, DANILO	BIRMINGHAM CITY UNIVERSITY, UNITED KINGDOM	
STURLA, GINO	UNIVERSITY OF FLORENCE, ITALY	Parallel Session 6, Medina
SU, QI	UNIVERSITY OF CHINESE ACADEMY OF SCIENCES, CHINA	Parallel Session 8, Enrique Iglesias
SUDER, GABRIELE	FEDERATION UNIVERSITY, AUSTRALIA	
SUH, SANGWON	UNIVERSITY OF CALIFORNIA, SANTA BARBARA, UNITED STATES	Parallel Session 6, Fernando Fajnzylber
SUN, JIALU	SCHOOL OF ECONOMICS AND MANAGEMENT, UNIVERSITY OF CHINESE ACADEMY OF SCIENCES, CHINA	Parallel Session 3, Aula I
SUN, LAIXIANG	DEPARTMENT OF GEOGRAPHICAL SCIENCES, UNIVERSITY OF MARYLAND, UNITED STATES	
TANG, JUN	BEIJING NORMAL UNIVERSITY, CHINA	
TEIXEIRA, ALEXANDRE	NATIONAL WATER AND SANITATION AGENCY OF BRAZIL, BRAZIL	
TEMURSHO, UMED	IOPEDIA, SPAIN	Parallel Session 4, Aula I
TEN RAA, THIJS	UTRECHT U, NETHERLANDS	
TERAN-VARGAS, JOSE	INEGI, MEXICO	Parallel Session 4, Fernando Fajnzylber
THIERFELDER, KAREN	U.S. NAVAL ACADEMY, UNITED STATES	
THOMSEN, SIMON	AALBORG UNIVERSITY, DENMARK	Parallel Session 8, The Executive Room
TIAN, KAILAN	ACADEMY OF MATHEMATICS AND SYSTEMS SCIENCE, CHINESE ACADEMY OF SCIENCES, CHINA	Parallel Session 6, The Executive Room
TOBARRA-GOMEZ, MARIA A.	UNIVERSIDAD DE CASTILLA - LA MANCHA, SPAIN	
TODA, HARUKA	KYUSHU UNIVERSITY, JAPAN	Parallel Session 6, The Executive Room
TOKITO, SHOHEI	YAMAGATA UNIVERSITY, JAPAN	
TOLEDO, VICENTE	UNIVERSIDADE FEDERAL E MINAS GERAIS, BRAZIL	
TOMÁS, MANUEL	BASQUE CENTRE FOR CLIMATE CHANGE, SPAIN	
TONON, MARCELO	FEDERAL UNIVERSITY OF RIO DE JANEIRO, BRAZIL	
TORCHINSKY LANDAU, MATÍAS	UNSAM/CONICET, ARGENTINA	Parallel Session 5, Aula I
TORRES, LUIS DANIEL	UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO, MEXICO	Parallel Session 3, Aula I
TSEKERIS, THEODORE	CENTRE OF PLANNING AND ECONOMIC RESEARCH (KEPE), GREECE	
TSUDA, KAORU	KYUSHU UNIVERSITY, JAPAN	Parallel Session 7, Medina
TSUKIOKA, AOI	KYUSHU UNIVERSITY, JAPAN	Parallel Session 3, Z-407
TSURU, JUNJI	KYUSHU UNIVERSITY, JAPAN	Parallel Session 5, The Executive Room
UCHIDA, YOKO	INSTITUTE OF DEVELOPING ECONOMIES, JAPAN EXTERNAL TRADE ORGANIZATION, JAPAN	Parallel Session 6, Enrique Iglesias
UEHARA, SHO	KYUSHU UNIVERSITY, JAPAN	Parallel Session 9, The Executive Room
USHIJIMA, DAIGO	GRADUATE SCHOOL OF ECONOMICS, KYUSHU UNIVERSITY, JAPAN	Parallel Session 5, Medina
USSAMI, KEYI	FEA-USP - SCHOOL OF ECONOMICS, BUSINESS AND ACCOUNTING, UNIVERSITY OF SAO PAULO, BRAZIL	

FULL NAME	INSTITUTION, COUNTRY	CONFERENCE PRESENCE
VALDECANTOS, SEBASTIAN	AALBORG UNIVERSITY, DENMARK	Parallel Session 7, The Executive Room
VALLECILLA, JAIME	CRECE, COLOMBIA	Parallel Session 7, Aula I
VALLES CODINA, ORIOL	UNIVERSITY OF LEEDS, UNITED STATES	Parallel Session 8, The Executive Room
VAN DER MENSBRUGGHE, DOMINIQUE	PURDUE UNIVERSITY, UNITED STATES	
VAN ZEIST, WILLEM-JAN	WAGENINGEN ECONOMIC RESEARCH, NETHERLANDS	
VARGAS, YAMIL	INTERNATIONAL MONETARY FUND, UNITED STATES	
VASQUEZ, DIEGO	UNIVERSIDAD ANDRÉS BELLO, CHILE	Parallel Session 9, Enrique Iglesias
VERMA, RAJAT	CENTRE FOR SOCIAL AND ECONOMIC CHANGE, INDIA	
VERONES, FRANCESCA	NTNU, NORWAY	
VERONESE PASSARELLA, MARCO	LINK CAMPUS UNIVERSITY OF ROME; UNIVERSITY OF LEEDS, ITALY	
VERUETE VILLEGAS, IÑAKI	CHARLES UNIVERSITY ENVIRONMENT CENTRE, CZECH REPUBLIC	Parallel Session 3, Z-407 Parallel Session 8, Enrique Iglesias
VILLANI, DAVIDE	JOINT RESEARCH CENTRE, SPAIN	
VISENTIN, JAQUELINE	FEDERAL UNIVERSITY OF PARANÁ (BRAZIL), BRAZIL	Parallel Session 5, Z-407
WANG, QINGLING	NORTHWEST A&F UNIVERSITY, CHINA	
WANG, RUI	SHANGHAI LIXIN UNIVERSITY OF ACCOUNTING AND FINANCE, CHINA	Parallel Session 2, Medina
WANG, YAFEI	INSTITUTE OF NATIONAL ACCOUNTS, BEIJING NORMAL UNIVERSITY, CHINA	Parallel Session 3, Fernando Fajnzylber
WANG, YUHAO	UNIVERISTY OF MARYLAND, UNITED STATES	
WANG, ZHI	GMU AND UIBE, UNITED STATES	
WEBB, COLIN	OECD, FRANCE	
WEIDEMA, BO	AALBORG UNIVERSITY, DENMARK	
WEINZETTEL, JAN	CHARLES UNIVERSITY ENVIRONMENT CENTER, CZECH REPUBLIC	
WIRKIERMAN, ARIEL	GOLDSMITHS, UNIVERSITY OF LONDON, UNITED KINGDOM	Parallel Session 6, Enrique Iglesias
WOLF, RAYAN	UNIVERSIDADE FEDERAL DE VIÇOSA, BRAZIL	
WONG, KHEE FUNG	STATISTICS NETHERLANDS, NETHERLANDS	
WOOD, RICHARD	NTNU, NORWAY	
WU, KAIYAO	SHANGHAI UNIVERSITY OF INTERNATIONAL BUSINESS AND ECONOMICS, CHINA	Parallel Session 4, Enrique Iglesias
XINQUAN, GE	WUHAN UNIVERSITY, CHINA	
XU, LIXIAO	ZHEJIANG UNIVERSITY OF FINANCE & ECONOMICS, CHINA	
XU, RAN	SCHOOL OF MANAGEMENT ENGINEERING, QINGDAO UNIVERSITY OF TECHNOLOGY, CHINA	Parallel Session 1, Z-407
XU, SHENGYI	WUHAN UNIVERSITY, CHINA	
XU, XIAOYUE	UNIVERSITY OF CHINESE ACADEMY OF SCIENCES, CHINA	
XUE, RUI	INSTITUTE OF SCIENCE AND TECHNOLOGY INFORMATION, BEIJING ACADEMY OF SCIENCE AND TECHNOLOGY, CHINA	
YAJIMA, GIULIANO TOSHIRO	LEVY ECONOMICS INSTITUTE OF BARD COLLEGE, BRAZIL	Parallel Session 7, The Executive Room
YAMAGUCHI, SOTA	KYUSHU UNIVERSITY, JAPAN	
YAMANO, NORIHIKO	OECD, FRANCE	Parallel Session 4, Medina Parallel Session 7, Fernando Fajnzylber
YANG, CUIHONG	SOUTH BUILDING, ACADEMY OF MATHEMATICS AND SYSTEMS SCIENCE, CAS, CHINA	
YE, JIABAI	HUNAN UNIVERSITY, CHINA	
YE, MING	OECD, FRANCE	
YOKOI, RYOSUKE	NATIONAL INSTITUTE OF ADVANCED INDUSTRIAL SCIENCE AND TECHNOLOGY (AIST), JAPAN	
YONGBIAO, FANG	RENMIN UNIVERSITY OF CHINA, CHINA	Parallel Session 6, Z-407
YOSHIDA, MOYO	KYUSHU UNIVERSITY, JAPAN	Parallel Session 6, Medina
ZAFRILLA, JORGE	UNIVERSITY OF CASTILLA-LA MANCHA, SPAIN	Parallel Session 2, Fernando Fajnzylber
ZANETTI DE LIMA, CICERO	GETULIO VARGAS FOUNDATION, BRAZIL	

FULL NAME	INSTITUTION, COUNTRY	CONFERENCE PRESENCE
ZHANG, CHUHAN	UCAS, CHINA	Parallel Session 3, The Executive Room
ZHANG, HONGZHI	BEIJING INSTITUTE OF TECHNOLOGY, CHINA	
ZHANG, JUNRONG	SCHOOL OF STATISTICS, UNIVERSITY OF INTERNATIONAL BUSINESS AND ECONOMICS, CHINA	
ZHANG, MEICHEN	UNIVERSITY OF INTERNATIONAL BUSINESS AND ECONOMICS, CHINA	
ZHANG, MINGWEI	UNIVERSITY OF CHINESE ACADEMY OF SCIENCES, CHINA	Parallel Session 8, Enrique Iglesias
ZHANG, XIAOXU	UNIVERSITY OF CHINESE ACADEMIC OF SCIENCES, CHINA	
ZHANG, XIN	BEIJING NORMAL UNIVERSITY, CHINA	
ZHANG, XUN	BEIJING NORMAL UNIVERSITY, CHINA	
ZHANG, YIBING	CAPITAL UNIVERSITY OF ECONOMICS AND BUSINESS, CHINA	
ZHAO, NAN	BEIJING NORMAL UNIVERSITY, CHINA	
ZHAO, XU	SHANDONG UNVERSITY AT WEIHAI, CHINA	
ZHAOYANG, JIN	RENMIN UNIVERSITY OF CHINA, CHINA	
ZHENG, HERAN	UCL, UNITED KINGDOM	Parallel Session 7, Medina
ZHENG, YU	CEPII, FRANCE	
ZHU, KUNFU	RESEARCH CENTER OF GLOBAL VALUE CHAINS, UIBE, CHINA	
ZHU, LINGXIU	UNIVERSITY OF GRONINGEN, NETHERLANDS	
ZÜRCHER, CARMEN	OECD, FRANCE	