Construction of Chinese Provincial Multi-regional Input-output Tables

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Motivation

- **There are many issues that could be investigated by MRIOs**
  - Environment and climate change (CO_2, SO_2, NOx, PM 2.5 etc.)
  - Value added in trade
  - Roles of Chinese provinces in the World economy (B&R Initiative)

Motivation

- **Several problems of China's previous MRIOs**
  - The previous multi-year MRIO tables are at the aggregated regional level, which conceals the economic linkages between the provinces within the region;
  - Lack of long term MRIO tables;
  - The "top-down" method, using the national input-output (IO) tables to constrain the sum of the provincial IO tables, might lower the conciseness of the MRIO tables.

Principles and Choices

- **Keep reliable information as much as possible**
  - Keep the total output unchanged, and try not to change the intermediate use and the value added;
  - Use the minimizing cross entropy method;
- **Choose the 'bottom-up' method**
  - "Known uncertainties" (bottom-up) " vs. "unknown uncertainties" (top-down);
  - Keep more information of the the high-quality provincial tables;
  - Coincident with the other provincial accounts (e.g. energy);
- **Use National Account data as a benchmark**
- **No entrepôt**
  - Sources/destinations customs data

Data

- Provincial SRIO tables published by NBS
- National Account data
- Customs data
- Railway transportation data
- Other provincial data

Methods

- **Step 1. Estimating the initial four-column trade data**
  - Estimating international trade
    - Sector of goods: customs data
    - Sector of construction and services
      - Relevant statistical indicators
      - Regression model
      - Distributing national-level data
  - Estimating provincial trade
    - Two columns of trade data: deducting
    - Only one column of net outflows: by ratios between inter-provincial inflows/outflows and total output in the previous IO year

Methods

Input \ Output		Intermediate use			Final demand			Imports	Provincial inflows	Total output
		Sector 1	……	Sector 31	……	Exports	Provincial outflows			
Intermediate input	Sector 1 … Sector 42	Z			Y	ex	pex	im	pim	x
Value added		V								
Total input		x								

But for each sector,
$\sum pex \neq \sum pim$

Methods

- **Step 2. Balancing inter-provincial outflows and inflows**
  - Minimizing cross entropy method
  - Basic model:

$$\min\left(\sum_i\sum_j h_{ij}\left(\ln h_{ij}-\ln \bar{h}_{ij}\right)\right)$$

Subject to:

$$\sum_i h_{ij}=1\ (i=1,2,\dots,n;\ j=1,2)$$

$$0\le h_{ij}\le 1\ (i=1,2,\dots,n;\ j=1,2)$$

$$\boldsymbol{H}\cdot\mathbf{q}_{\mathbf{ctrl}}+\mathbf{tz}+\mathbf{tc}+\mathbf{tp}+\mathbf{ex}-\mathbf{im}+\boldsymbol{err}=\mathbf{x}$$

$$|\boldsymbol{err}|\le 0.05\cdot\mathbf{x}$$

$$\mathbf{ex}+\boldsymbol{pex}\le\mathbf{x}$$

$$\boldsymbol{pex}=\boldsymbol{H}_{\cdot,1}\mathbf{q}_{\mathbf{ctrl}_1}$$

Methods

- **Step 2. Balancing inter-provincial outflows and inflows**
  - Situation 1: When feasible solutions are only available for part of the sectors…
    - Firstly, the inter-provincial trade is balanced at the aggregated level (the three-industry level);
    - Then, within each industry, the sectors are modeled together to get the balanced values.

Methods

- **Step 2. Balancing inter-provincial outflows and inflows**
  - Situation 2: When the solution space is empty…
    - Intermediate use and value-added are involved to help balance the inter-provincial trade;
    - First, adjust the sum table of the standardized provincial IO tables (IOT-As) to get the provincial inflows equal to the provincial outflows;
    - Second, with the results of the first step as sum controls, the IO data are balanced by sector.
    - Finally, several extra steps are be included to rebalance the IO tables.

Methods

- **Step 3. Linking provincial IO tables with inter-provincial trade flows**
  - Step 3.1 Estimating the initial trade flow matrices between provinces for each sector
    - Gravity model

$$\bar{f}_{s.r}^{k} = e^{\alpha}(SP_s^k)^{\beta_1}(DM_r^k)^{\beta_2}\frac{(GS_s)^{\beta_3}(GS_r)^{\beta_4}}{(d_{s,r})^{\beta_5}}$$

Railway transportation data;

Distances between provinces (the minimum railway distances);

Methods

- **Step 3. Linking provincial IO tables with inter-provincial trade flows**
  - Step 3.1 Estimating the initial trade flow matrices between provinces for each sector
    - Alternative approach: construction, utilities and services

$$\bar{f}_{s.r}^{k} = pex_{s}^{k} \frac{pim_{r}^{k}}{\sum_{i} pim_{i}^{k}}$$

Methods

- **Step 3. Linking provincial IO tables with inter-provincial trade flows**
  - Step 3.2 Benchmarking the trade flow matrices against the balanced provincial trade

$$\min\left(\sum_s\sum_r h_{s,r}\left(\ln h_{s,r}-\ln \bar{h}_{s,r}\right)\right)$$

$$s.t.\begin{cases}\boldsymbol{H}\cdot\mathbf{pim}=\mathbf{pex}\\ \sum_s h_{s,r}=1\\ 0\le h_{s,r}\le 1\end{cases}$$

Methods

- ***Chinese provincial MRIO tables***
- ***(Extended Chinese Regional Input-Output Table)***

Output / Input	Intermediate use: Sector 1	……	Sector 42	Final demand: ……	Exports	Provincial outflows	Imports	Provincial inflows	Total output
Intermediate input: Sector 1	Z			Y		pex = ∑PEX		pim = ∑PIM	x
Intermediate input: Sector 42									
Value added	V								
Total input	x								

Provincial outflow matrix	Province 1	……	Province 31
Sector 1	PEX		
Sector 42			

Provincial inflow matrix	Sector 1	……	Sector 42
Province 1	PIM		
Province 31			

Our Progress

1995 | Interregional Input-Output Table for **1987; 9 sectors, 7 regions**

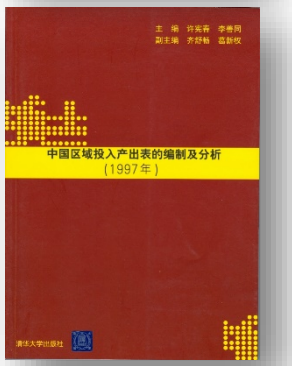
2003 | Publication of *Interregional Input-Output Analysis of the Chinese Economy (English)*

2004 | Publication of *Interregional Input-Output Analysis of the Chinese Economy (Japanese)*

2006 | Publication of *Interregional Input-Output Analysis of the Chinese Economy (Chinese)*

2008 | Interregional Input-Output Table and Provincial MRIO for **1997; 40 sectors, 30 provinces**

2008 | Publication of *Construction and Analysis of Chinese Regional Input-Output Table 1997*



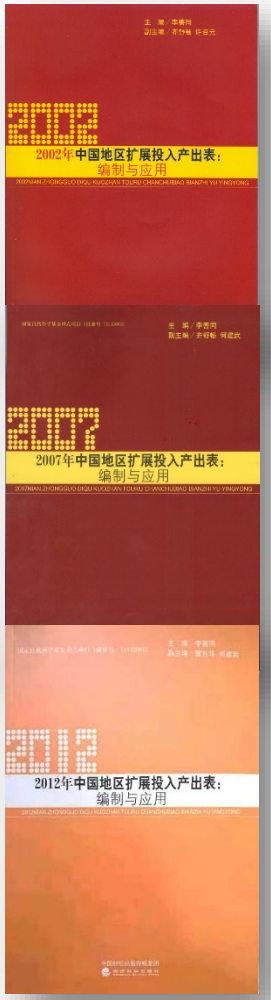
Our Progress

2010 | Provincial MRIO for **2002; 42 sectors, 30 provinces**
2010 | Publication of *2002 Extended Chinese Regional Input-Output Table: Construction and Application*

2014 | Provincial MRIO for **2007; 42 sectors, 30 provinces**
2016 | Publication of *2007 Extended Chinese Regional Input-Output Table: Construction and Application*

2017 | Provincial MRIO for **2012; 42 sectors, 31 provinces**
2018 | Publication of *2012 Extended Chinese Regional Input-Output Table: Construction and Application*

2018 | Provincial MRIO for **1992; 33 sectors, 29 provinces**
2019 | In progress: Provincial MRIO for 1987



Applications of Our MRIOs

- **Models Based on the MRIOs**
  - Social Accounting Matrix
  - Chinese CGE Models
    - Methodology
    - Resource-Economy-Environment CGE Model
    - Labor Migration and Economy Growth
    - … …

Applications of Our MRIOs

- **Projects**
  - NSFC, Research on Domestic Regional Division and Market Integration from the Perspective of Global Value Chain, *In Progress*.
  - MOFCOM, Analysis domestic trade in value-added for provinces, *In Progress*
  - NSFC, Research on China's Regional Coordinated Development and Regional Policy Analysis Model in Globalization, *Completed*.
  - The Research Council of Norway, Transforming China onto a Low Carbon Pathway, *Completed*.
  - ADB, Analysis of Climate Change and Policy in People's Republic of China, *Completed*.
  - And so many more…

Thank You!

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