

7th International Conference of the European Society for Ecological Economics
5-8th June 2007, UFZ - Centre for Environmental Research in Leipzig, Germany



Quantifying indirect material flows of traded products with a multi-regional environmental input-output model

Stefan Giljum (SERI), Christian Lutz, Ariane Jungnitz (GWS)

Structure

Background: trade and resource consumption

Indirect material flows: concepts

Global, multi-regional IO-MFA model

Shortcomings and improvements

Areas of application



Resource productivity and environmental tax reform in Europe
www.psi.org.uk/petre

Background: trade and resource consumption

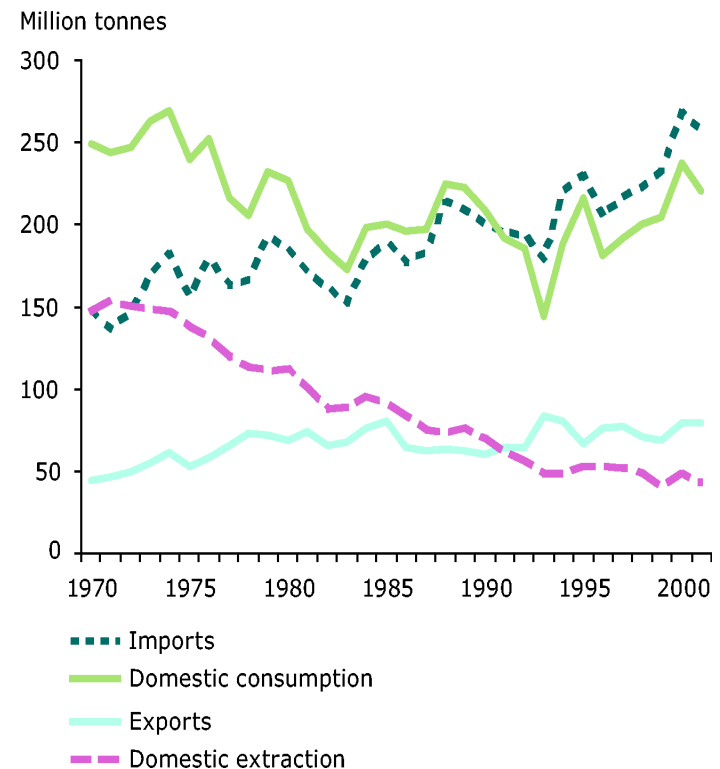
Increasing international trade (6.5% p.a., 1990-2005)

Outsourcing of material intensive stages of production processes

Environmental indicators must include trade dimension

Up-stream material requirements

Relocation of environmental burden



Metal Ores, EU-15 (EEA, 2006)

Indirect material flows: concepts

Material requirements along the production chain to produce imports (and exports) - „embodied“ material requirements

Two main approaches (& combinations)

(1) LCA-oriented approach:

„Rucksack factors“ at product level

Advantage: disaggregation into single products

Problem: limited data availability for higher manufactured products

(2) Input-output analysis:

Advantage: coverage of whole production system (national/international)

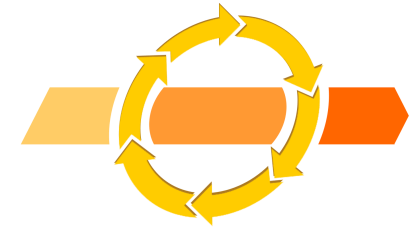
Problem: higher level of aggregation (sectors/product groups)

So far: assumption of similar production structures

Multi-regional IO-MFA model: foundations

- + Multi-regional environmental IO model (MRIO)
- + Economic core model: IO tables linked by bilateral trade
- + Extended by material flow accounts in physical units
188 countries; > 200 material categories, 1980-2002
(see www.materialflows.net)
- + Coverage: 52 countries plus 2 regions (OPEC & RoW)

www.materialflows.net
The online portal for material flow data



Multi-regional IO-MFA model: data sources

+ IO tables:

- OECD 2006 edition: 37 countries / 48 harmonised sectors
- Assumptions for economic structure of 15 additional countries and 2 world regions

+ Trade data:

- OECD Bilateral trade data: 61 trading partners / 25 product groups (harmonised with IO tables)
- Completed by UN COMTRADE data for trade between non-OECD countries

+ Material input data:

- Global MFA data set (MOSUS project)

Multi-regional IO-MFA model: calculation

Based on approach introduced by Ahmad and Wyckoff (2003) for CO2 emissions embodied in international trade of OECD countries

Four categories of material use:

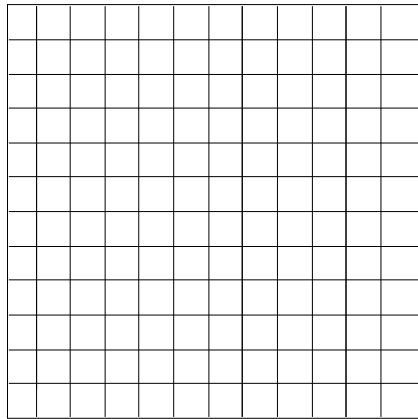
- (1) Extracted domestically – consumed domestically
- (2) Extracted domestically – exported
- (3) Imported – consumed domestically
- (4) Imported – re-exported

Material flow-based indicators:

$$\text{TMR} = 1+2+3+4 \quad \text{TMC} = (1+3) - (2+4) \quad \text{PTB} = 3 - (2+4)$$

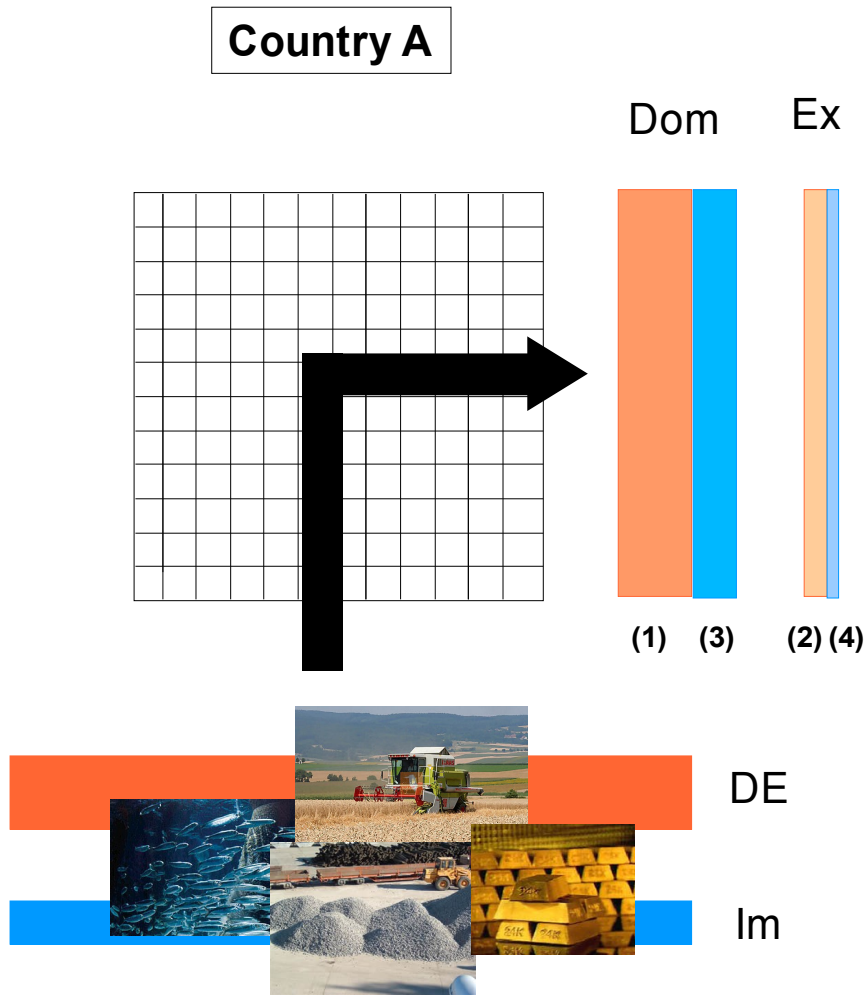
Multi-regional IO-MFA model: calculation

Country A

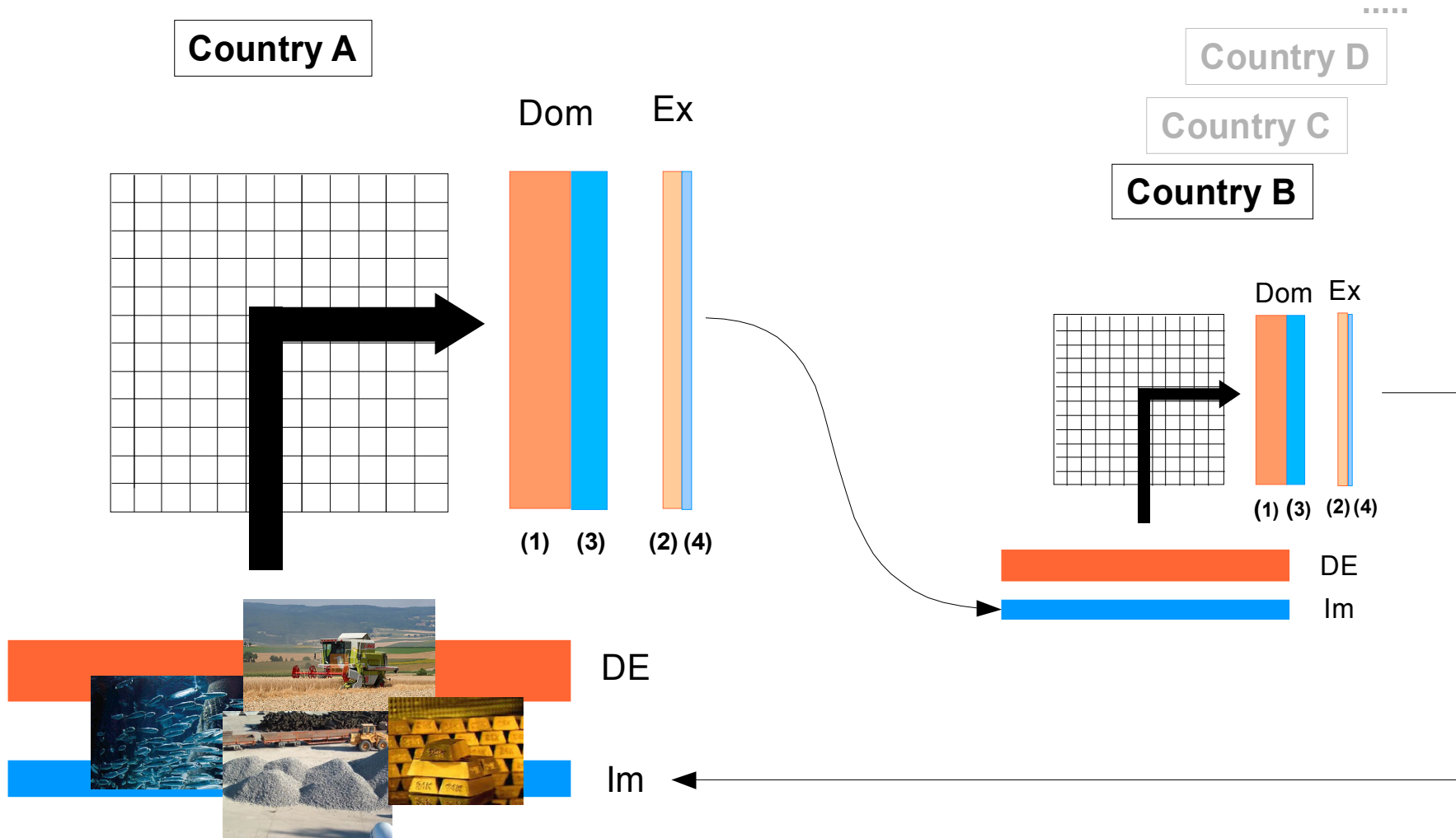




Multi-regional IO-MFA model: calculation



Multi-regional IO-MFA model: calculation



Shortcomings and improvements

+ Hybrid IO tables:

- Allocation based on economic vs. physical causalities
- Additional physical information for first steps of processing

+ Improvement of IO tables:

- Deeper sectoral disaggregation (more material categories)
- Replacing assumed IO tables by real data
- Disaggregate larger number of countries (from RoW)

Areas of application

- + Calculation and analysis of **indirect (embodied) material flows**
by product groups / industries; material categories; origin and destination of imports and exports
- + Calculation of comprehensive **MF-based indicators**
- + Analysis of international **production chains** and **structural paths**: priority areas for policy intervention
- + **Historical analysis**: links between growth, structural change, international trade and distribution of environmental pressures
- + Modelling **future scenarios**: feeding back trade forecasts

The end Thank you!

More information:

www.seri.at

www.gws-os.de

www.psi.org.uk/petre

stefan.giljum@seri.at