


Policy Relevance of Consumption Based Accounting

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Presentation Elements

- Consumer based environmental accounting
  - What is it?
  - What are the main characteristics of ongoing projects?
  - What is the policy relevance ?
  - My own background
  - Manager at TNO, a large not for profit research institute in NL
  - Professor of Sustainable Innovation, Industrial Ecology Program, NTNU, Trondheim, Norway
  - Leader of EU funded MR EE IO projects of EXIOPOL and CREEA (total 6 Mio Euro, 10-15 partners)

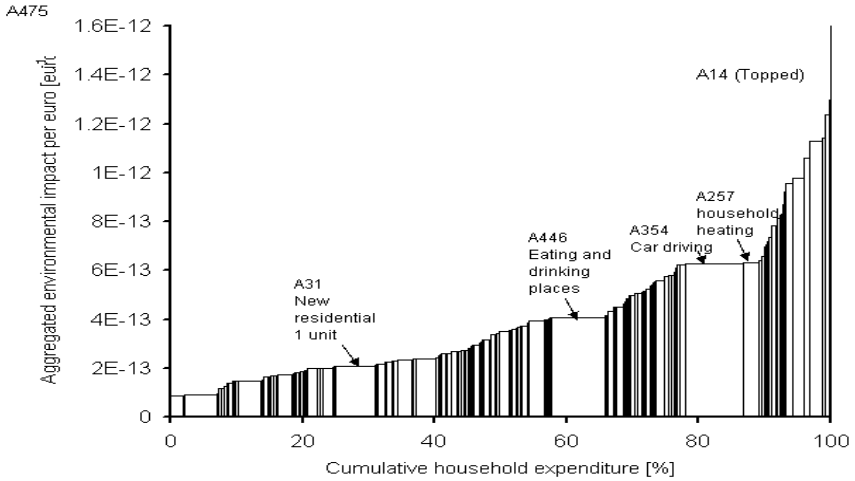
Consumption and Production based accounts – SUT and IOT

	Products	Industries			
Products		Use	Final use	Exports	*Use of products*
Industries	Make / Supply				*Output of industries*
	Imports cif	Value added			
	Supply of products	*Input of industries*			
		Extensions: - Primary Natural Resource input - Emissions output - etc.			

- EE SUT for a single country
  - Economic Supply and Use
  - By industry: emissions and primary resource use
- Can provide you
  - Per final use category: value added by industry
  - With impact per Euro per industry known: life cycle impacts per final use category
- Advantages
  - Inherently complete
  - Inherently consistent

What you can calculate with EE SUT and IOT

- EU EIPRO (480 sector EE IOT)
  - Priority setting of products
  - Proved that food, mobility and housing were prio's
- EU Diet change
  - Change to healthy diets by changing demand vector
  - Showed rebounds by linking EE IOT to the CAPRI model
- Limitations of official data in EU
  - Sector detail (60+)
  - Emissions (few or absent)
  - Imports estimated by 'domestic technology ass'



Tukker (ed., 2006), Journal Industrial Ecology 10: 3

	Aggregated environmental impacts (%)			
	Scenario 0: Status quo	Scenario 1: Recommendations	Scenario 2: Recommendations including red meat reduction	Scenario 3: Mediterranean
Sub-scenario 'All'				
Food	27	27	25	25
Non-food	73	73	73	73
Total	100	100	98	98
Sub-scenario 'All + first order'				
Food	27	27	25	25
Non-food	73	73	74	73
Total	100	100	99	98
Sub-scenario 'All + first and second orders'	100	100	99	99

Tukker et al., 2011, Ecological Economics (in press)

Alternative: LCA based consumer accounting

- Approach
  - Choose functional unit
  - Identify production chain system boundaries
  - Do emission inventory
  - Do impact assessment and interpretation
- Is more detailed but may be less consistent and give rise to truncation errors


So what you need: detailed Multi-Regional EE SUT SUT/IOT

- Ideal solution: a database that links country SUT/IOT via trade
  - Country SUT/IOT including value added and final demand (red)
  - Import and export trade matrices for intermediate and final demand (green)
  - Exensions: emissions, energy, materials (grey)
- Preferably with detail in environmentally relevant sectors..
- ..and many emissions/extensions

		Industries				$Y_{*,A}$	$Y_{*,B}$	$Y_{*,C}$	$Y_{*,D}$	q
Products		$Z_{A,A}$	$Z_{A,B}$	$Z_{A,C}$	$Z_{A,D}$	$Y_{A,A}$	$Y_{A,B}$	$Y_{A,C}$	$Y_{A,D}$	q_A
		$Z_{B,A}$	$Z_{B,B}$	$Z_{B,C}$	$Z_{B,D}$	$Y_{B,A}$	$Y_{B,B}$	$Y_{B,C}$	$Y_{B,D}$	q_D
		$Z_{C,A}$	$Z_{C,B}$	$Z_{C,C}$	$Z_{C,D}$	$Y_{C,A}$	$Y_{C,B}$	$Y_{C,C}$	$Y_{C,D}$	q_C
		$Z_{D,A}$	$Z_{D,B}$	$Z_{D,C}$	$Z_{D,D}$	$Y_{D,A}$	$Y_{D,B}$	$Y_{D,C}$	$Y_{D,D}$	q_D
W		W_A	W_B	W_C	W_D					
g		g_A	g_B	g_C	g_D					
C & L		$Capital_A$	C_B	C_C	C_D					
		$Labor_A$	L_B	L_C	L_D					
Environ Ext		$NAMEA_A$	$NAMEA_B$	$NAMEA_C$	$NAMEA_D$					
		$Agric_A$	$Agric_B$	$Agric_C$	$Agric_D$					
		$Energy_A$	$Energy_B$	$Energy_C$	$Energy_D$					
		$Metal_A$	$Metal_B$	$Metal_C$	$Metal_D$					
		$Mineral_A$	$Mineral_B$	$Mineral_C$	$Mineral_D$					
		$Land_A$	$Land_B$	$Land_C$	$Land_D$					


Major (research) initiatives in creating (Global) MR EE SUT/IOT

Project name	Funding	Countries	Type	Detail (ixp)	Time	Extensions	Approach
IDE JETRO (Inomata)	Japan	Asia Pacific (10)	MR IOT		2000, 2004	-	Harmonize IOT; Link via trade; move discrepancies to RoW
GTAP (Hertel)	Subscrip-tion	World (113)	MR IOT	58x58	2000, 2004	10 (GWP)	Harmonize trade; use IOT to link trade sets; relative crude IOT estimates
WIOD (Dietzenbacher, RUG)	EU FP7	World (40)	MR SUT	30x60	1995?-2000-2006	20+	Harmonize SUT; Link via trade; problems with discrepancies
EXIOPOL/ CREEA (Tukker, TNO & NTNU))	EU FP6/7	World (43)	MR SUT	129x129	2000, 2007	30 emissions, 60 IEA energy carriers; water, land, 80 resources	Create SUT bp; Split Use_dom and Use_imp; Detail and Harmonize SUT; Use trade shares to estimate implicit exports; confront with exports in SUT, RAS out differences, add extensions
AISHA/ EORA (Lenzen, Un. Syndney)	Austral-ian NSF	World, t.b.d. (200?)	MR SUT	t.b.d (>150?)	1990-2006?	t.b.d.	Create initial estimate; Gather all data available; apply in original format; Formulate constraints; Detect & judge inconsistencies; Let routine calculate Global MR SUT/IOT
Eurostat (Remond-Tiedrez, Moll)	Eurostat	EU 27 aggregate	SUT	59x59	1995-2007	10 (GWP)	Create SUT bp, Split intra and extra EU trade, aggregate to EU27 totals, remove intra EU imports / export differences to RoW, add extensions

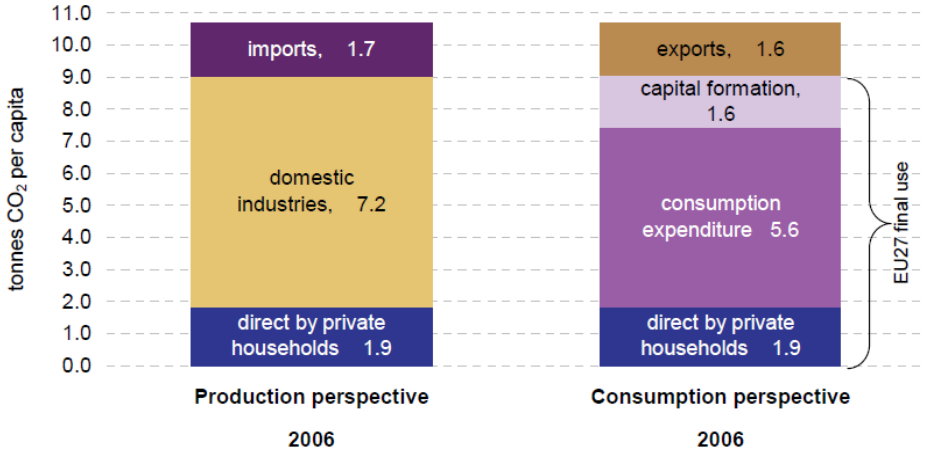
Note: WIOD seems only project that develops current and constant price tables

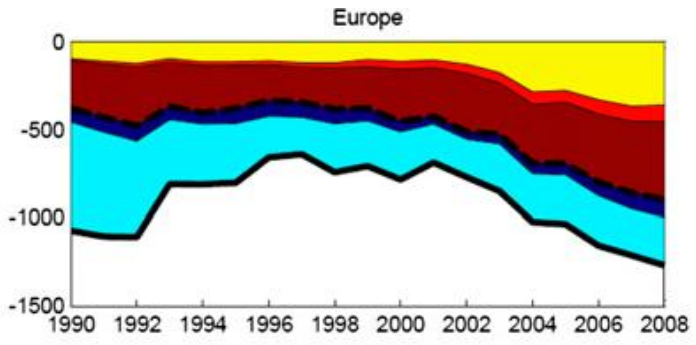

The contribution of EXIOPOL and CREEA

- EXIOPOL
  - Unique detail and large number of extensions
  - Focused on environmentally relevant sectors (agri, energy, mining, etc.)
- FP7 CREEA (Compiling and Refining Economic Environmental Accounts)
  - Willl be used to update EXIOBASE to 2007
  - Will expand EXIOPOL/EXIOBASE with physical accounts
  - Will improve water and land use accounts
  - Will further test SEEA 2012 carbon and forest accounts
  - We have funds reserved for intensive collaboration with formal circles (e.g. OECD, UNCEEA, UNEP ????)
- Done with partners like TNO, CML, WI, SERI, EU DG JRC IPTS, NTNU, 2-0 LCA, ETH, TU Twente (Water Footprint), CBS, SCB, EFI, others
- Have obviously NSIs in Advisory Boards

Example of policy relevant results: pollution embodied in trade

- Eurostat EU 27 EE SUT/IOT on carbon footprint
- One caveat
  - 'Domestic Technology Assumption" -> EU seems carbon-neutral in trade….
- …where other studies show carbon in imports is a factor 2-3 higher as in exports…..
- EXIOPOL can make such calculations for all 110 extensions





Net carbon trade EU. Peters et al, PNAS, 2010


Example of policy relevant results (2)

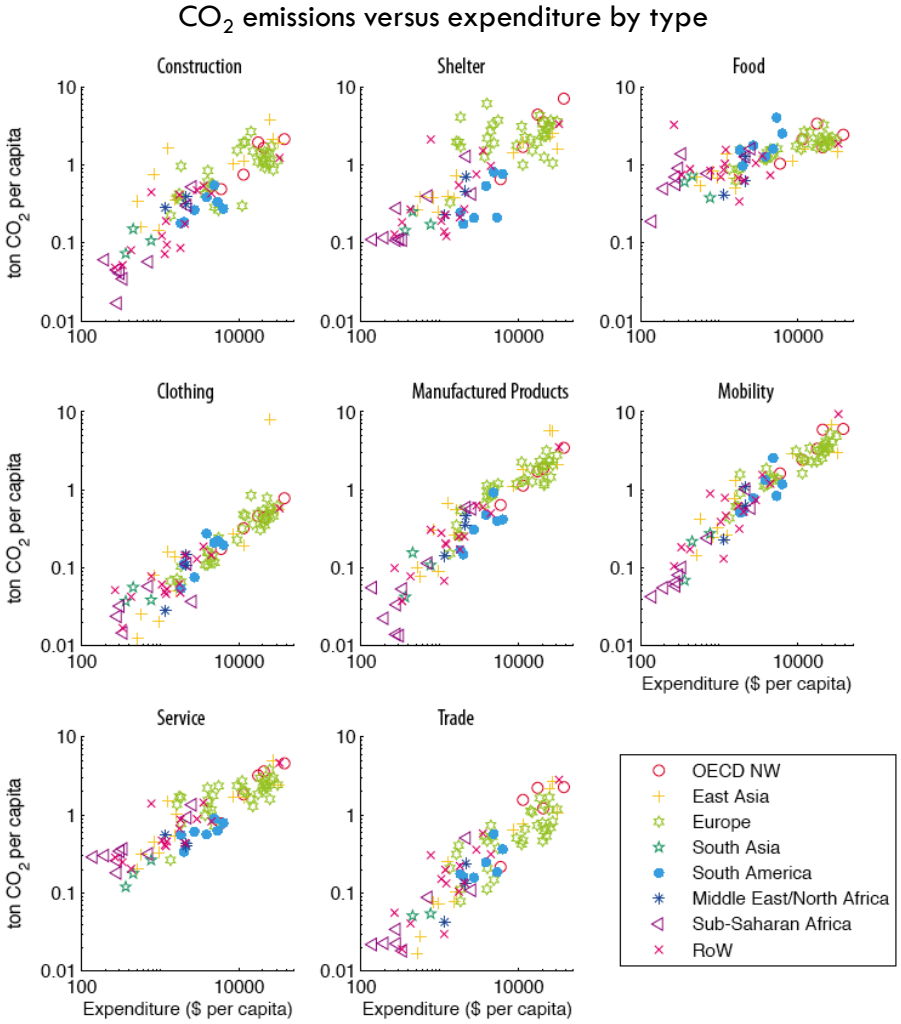
- Food: meat, dairy (25-30%)
- Mobilty: car and air transport (20-25%)
- Housing: heating, hot water and materials (>20%)
- Energy using products: lighting, fridge, other electrical products (>10%)

COICOP	Study	Dall et al.	Kok et al.	Labouze et al.	Nemry et al.	Nijdam and Wilting	CEDA EU25
	Indicator	Energy	Energy	GWP	GWP	GWP	GWP
	Main approach	Bottom-up	Hybrid	Bottom-up	Bottom-up	IO	IO
CP01-02	Food	26,2%	13,0%	7,0%NA	3,6%NA	22,1%	31,0%
CP03	Clothing	1,3%	2,2%	3,3%	1,3%	6,5%	2,4%
CP04-05	Housing	40,8%	54,3%	58,8%	53,5%	33,4%	23,6%
CP06	Health		1,8%		0,3%	0,3%	1,6%
CP07	Transport	19,5%	18,3%	29,6%	32,9%	17,3%	18,5%
CP08	Communication			0,0%	2,9%	0,0%	2,1%
CP09	Recreation	7,2%	8,1%	0,0%		15,1%	6,0%
CP10	Education		1,8%			0,7%	0,5%
CP11	Restaurants					2,8%	9,1%
CP12	Miscellaneous	5,1%	0,4%	1,3%	5,4%	1,8%	5,2%
	TOTAL	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Source: EIPRO.

Example of policy relevant results (3)

- UNEP Resource Panel Report, Hertwich, Tukker et al. 2010
  - Comparting CO2 emissions by final expenditure by country (GTAP)
  - Doubling of household consumption expenditure gives 80% more CO_2
  - This picture holds for all final consumption categories




So food, housing and mobility are important – one size fits all?

		Food		**Mobility**		**Housing**
The system..	Score	Comment	Score	Comment	Score	Comment
Agreement on goals	Low	Disconsensus on GMOs, biological food, food miles	Medium	Reducing congestion, emissions accepted, transport volume not	High	Zero-energy houses accepted
Agreement about means	Low	See above	Low	No success stories	Medium	Illustrations available, mainstreaming seems difficult
Geographical characteristics	Global	Most modern food chains span the globe	Global /local	Few manufacturers, local alternatives vary	Local	The building industry is locally organised
Power nodes in the system		Retailers, major food companies		Car producers, infrastructure providers		Varies per country: social housing agencies, land owners, developers, or customers
Potential for…						
Consumer-driven change	Medium	Consumers can change but locked in by habits	Low	Consumers have often limited choice	Low	consumers have little power on buildings.
Producer-driven change	Medium to high	Retailers (e.g. choice editing), major food companies (cf MSC)	Low to medium	Car industry locked in, alternatives in niches	Medium	Mainstreaming difficult
Government driven change	Medium	GPP and standards	Medium to high	Spatial planning, public transport	Medium	Labelling, standardsa
Main challenges		Negotiating a view on sustainable food and implementing this.		Overcoming various lock-ins		Mainstreaming of proven practices


Or, summarizing

- Food: create consensus on sustainability challenge and implement via food chains
- Mobility: overcome lock in’s and offer alternatives of similar quality
- Housing: proof of concept is there, push implementation through


Conclusions

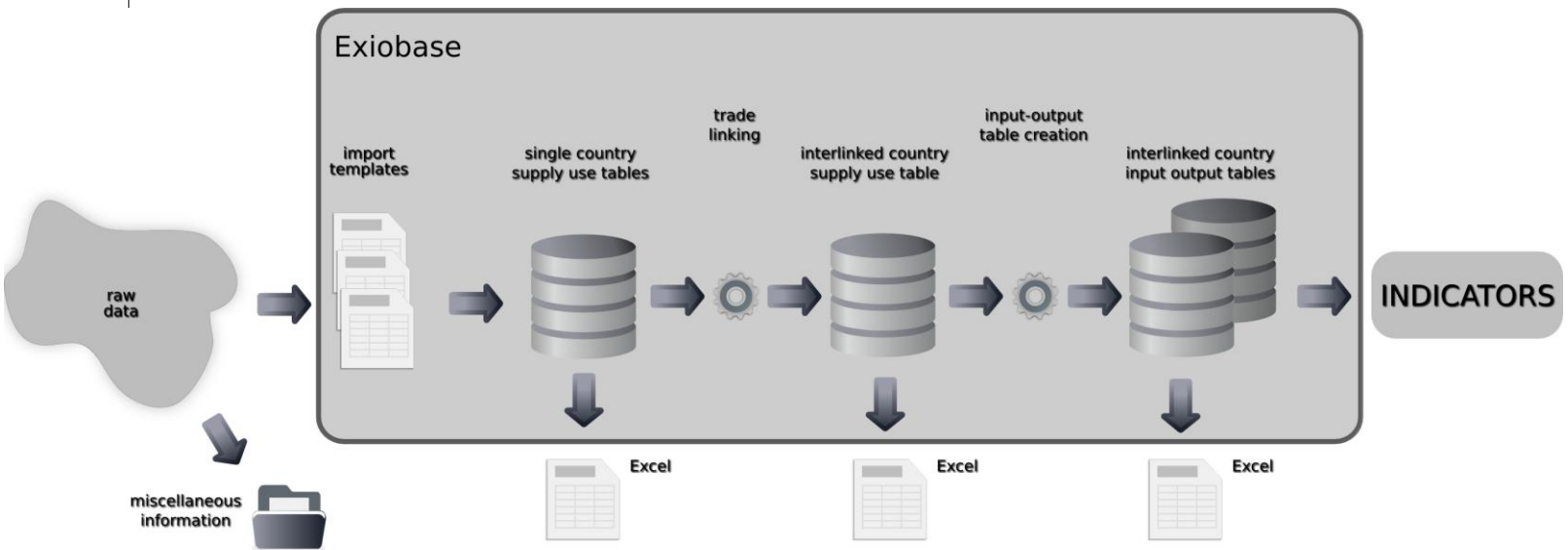
- Consumer based environmental accounting is relevant
- In a globalized world pollution embodied in imports become more and more relevant
- (MR) EE IO is a comprehensive tool that can be used
  - To assess priorities
  - To monitor historical developments
  - To extrapolate to the future
- Policy implications – the recipe for change differs by consumption domain


TNO innovation for life

THANKS FOR YOUR ATTENTION!

The contribution of EXIOPOL & CREEA

- The EXIOBASE database has 3 main blocks:
  - 1: Make harmonized EE SUT (EU27+16 others > 95% global GDP)
    - 130 sectors & products
    - 30 emissions, 80 resources, 60 IEA energy carriers, land, water
    - Handles indicators like EF, MFA, external costs, LCIA
  - 2: Split Use imp and Use dom, link via trade to global MR EE SUT
    - Split up Use import via UN COMTRADE trade shares
    - Yields implicit exports // exports in S -> rebalancing needed..
    - ...affects tables & GDP but alternative is 'trade with aliens'
  - 3: Make global pxp and ixi MR EE IOT by collapsing MR EE SUT



Relations between SUT and IOT

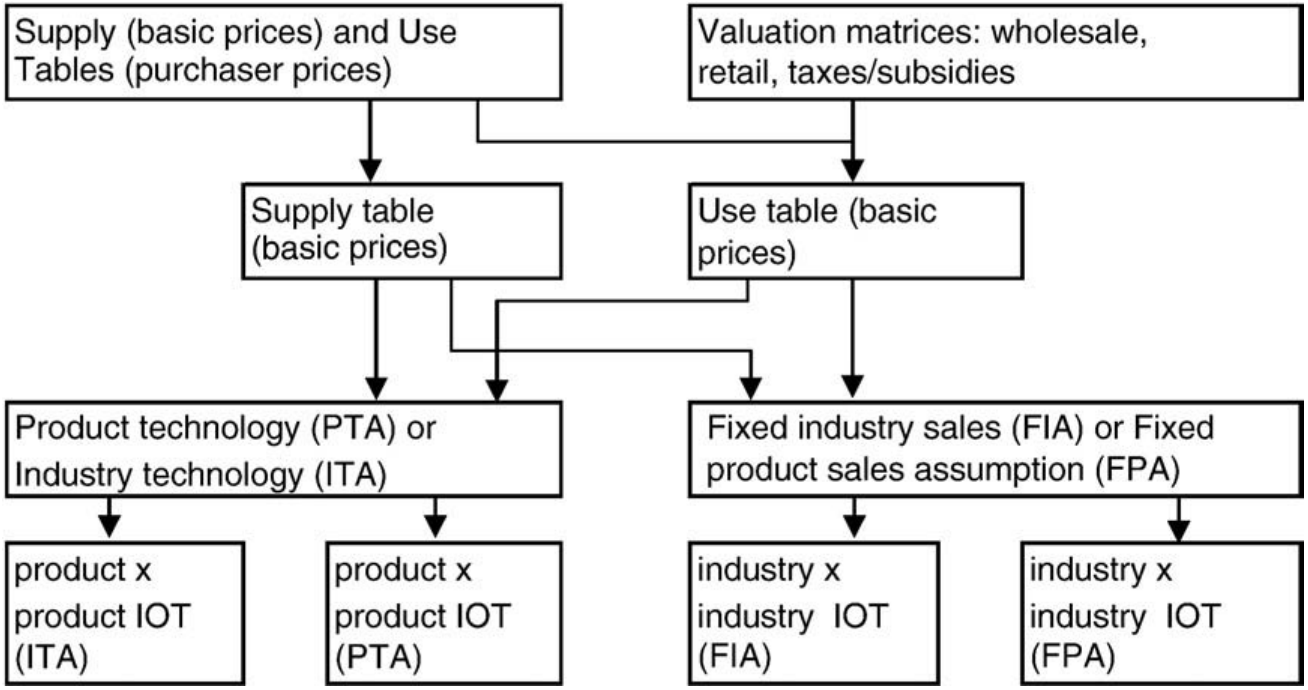


Figure courtesy of Jose Rueda Cantuche, EU DG JRC IPTS, Sevilla, Spain


How EXIOPOL did produce its data set - SUT

- Working with SUT as core *(// GTAP, IDE)*
  - Trade and FD is in products
  - Emissions and resource extractions are by Industry
- Production routine
  - Gather and create balanced SUT in bp in original sector format
    - EU: Eurostat SUT with S in bp, U in pp, few give valuation layers - > reverse engineer Ubp from IOT and Sbp
    - Non EU: often IOT, heroic assumption of diagonal S
  - Detail
    - Map SUT bp on EXIOPOL classification
    - Úse auxiliary information and optimisation routine to create detail
      - AgriSAMS for food and agriculture
      - IEA database, information on material extraction, LCA co-efficients, SUT/IOT othe countries for estimated co-efficients


How EXIOPOL created its data set - EE

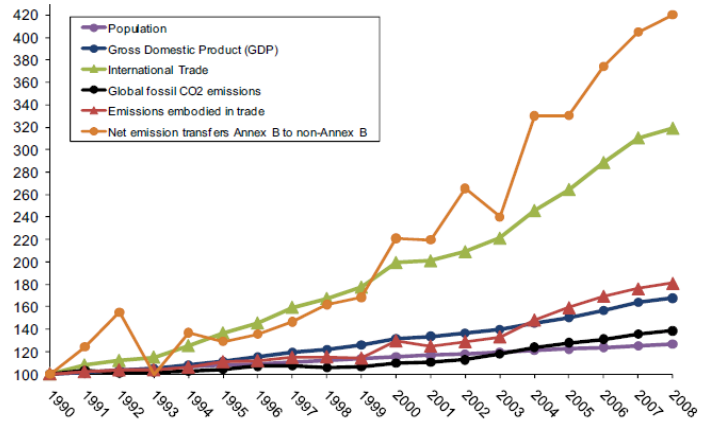
- Resources: allocation SERI (FAO, USGS, etc.) database to extracting sectors
- Emissions
  - Allocation of EIA database to sectors + emission factors (IPCC, CLRTAP, etc.)
  - Other activity variables + emission factors
- Land, Water: mainly FAOSTAT plus allocation

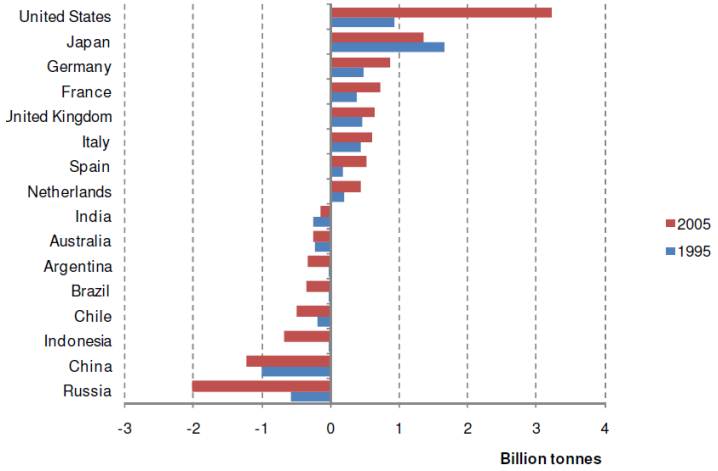

How EXIOPOL created its data set – Trade links

- Use bp is separated in Use dom and Use imp
- Use imp is further allocated to country of origin with trade shares (harmonized UN COMTRADE by Feenstra et al.)
- When we do so for all countries, we get an ‘implicit export’ by country that in theory should match export vector in Use table
- It does not due to
  - Valuation differences (cif versus fob)
  - Statistical differences / error
- We match this by
  - Using Exports in SUT as constraint;
  - Rescaling so that total imports = total exports at global level
  - GRAS is applied to the bilateral Import Use tables to get a balanced system

Relevance of imports - MR EE SUT and IOT

- Peters et al., PNAS 2010:
  - Global CO2 emissions (black)
  - Transfer from Annex B to non Annex B (yellow)
  - Similar work of Ahmad and Wyckoff, 2003, Davis and Caldeira, 2010
- Giljum et al. (in press)
  - Focuses on materials
  - Gives net materials imports and exports in trade






Longer term roadmap ideas for EE SUT/IOT

- Further harmonization of SUT/IOT in more detail
- Expanding number of countries covered
- Integration with physical data to P-SUT (e.g. with FAO and IEA data)
- Harmonizing trade data sets/shares (both economic as physical)
- Integration of Life cycle inventory data (is SUT/IOT by single process)
- Integration of spatially explicit information for land and water use
- Inclusion of monetary and physical capital stocks


Some issues about data availability

- Eurostat works with
  - IPTS and Konstantz on gap filling ESA95 SUT
  - TNO, RUG, NTNU, CML on creating an EE SUT
- For 16 out of 27 EU countries (75% GDP) an ‘Excellent data set’
  - 3-4 countries with valuation layers transmitted to Eurostat
  - 12 other countries that give voluntary information, but many do not want to have this published!!!!!
- Even in our Eurostat project we could not work with these tables
- We will publish
  - Aggregated EU27 table constructed by separating Uimp, non EU and Uimp, EU, rebalancing intra EU trade
  - With extensions, and several analyses
- In a way weird – WIOD, EXIOPOL are forced to redo this work with less information…..hope with time this will improve