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Chaire Modélisation prospective  
au service du développement durable

# Addressing a self-trade issue in *GTAPAgg*

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# Outline

1. Introduction : GTAP and GTAPAgg
2. The «*self-trade*» phenomenon
3. A new aggregation procedure to correct the '*self-trade*' issue
4. Illustration
5. Concluding comments

# Global Trade Analysis Project GTAP

- **Global network** of researchers and policy makers  
groups more than 6700 researchers in more than 150 countries
- Helps and allows many economists to conduct **quantitative analysis** of international policy issues, **since 1992.**
- The project is coordinated by the **Centre for Global Trade Analysis in Purdue University's Department of Agricultural Economics.**

# GTAP database

- The **GTAP network** cooperates to **produce the database** that is probably **the most used** in general equilibrium modelling exercises
- A unique characteristic:  
providing a comprehensive and harmonized **global database** at a remarkable level of detail:  
  
in the 7<sup>th</sup> version: **57 sectors , 113 regions and 5 factors**  
cover the entire global economic activity for the **year 2004**.
- The database describes (among other things):
  - bilateral trade flows, production, consumption and intermediate use of goods and services.

# GTAP database and GTAPAgg

- The most important feature of the **GTAP database : Strictly balanced**
  - **Regional level**: each of the 57 sectors are balanced in income and expenditure for each of its 113 regions.
  - **International level: bilateral trade flows data across all regions strictly compensate**
- Particular efforts have been made by the GTAP team
  - Collecting and scrutinizing national and regional data to build ‘local’ IO tables
  - **Reconciling bilateral trade data** coming from many different sources  
*To combine them in a consistent way into the database*
- **GTAPAgg**: A user-friendly software that computes values of the series of the database
  - **for any region, sector and factor aggregation**
  - a modeller willing to use GTAP data and for calibration purposes naturally turns to **GTAPAgg**

# The « *self-trade* » phenomenon

The **GTAPAgg** programme has one limitation:

- it **aggregates** the several series concerned with **international trade** like any other series  
*by simply summing them up*

→ The resulting series **include** a share of exports and imports happening between the aggregated regions,

*which should rather be treated as **trade flows internal to the aggregated region***

- ***self-imports (self-exports)*** corresponding to importations (exportations) of an aggregated region from (to) itself ***are not equal to zero***
- and the *imported shares of each detailed expenditure is not corrected.*

# Illustration: The global IO table

This 'self-trade' issue is best illustrated  
with a *straightforward example*:

→ *the global IO table, for*

- *one region (the world),*
- *one good,*
- *and one factor*

→ *that a use of GTAPAgg produces*

# Illustration: The global IO table

... aggregated from GTAPAgg (in thousand billion 2004 USD)

*In parenthesis: expenditures or taxes on imported goods*

	Intermediate Consumption	Consumption of households	Public consumption	Investment	Exports	Total Expenditure
Intermediate consumption	39.4 (6.8)	25.2 (2.8)	7.1 (0.2)	8.7 (1.4)	10.5	90.9
1 <sup>ary</sup> factor payments	32.5					
Taxes	8.5 (0.7)					
Imports	10.5					
Total Resource	90.9					

*The World exhibits global exports and imports to itself that amount to ...*

**26% of the  
global GDP**

**Perfectly balanced.....**

.....for the world aggregated as one region **all goods are domestic ones** .... But..

By accounting for global exports and imports

—————→ **overestimation** of total global resources and total global expenditures by

**\$10.5 trillion (~ +12%).**

# A regional aggregation

**An EU27 IO table aggregated from GTAPAgg (in thousand billion 2004 USD)**  
 In parenthesis: expenditures or taxes on imported goods

	Intermediate Consumption	Consumption of households	Public consumption	Investment	Exports	Total Expenditure
Intermediate consumption	13.3 (2.7)	7.7 (1.3)	2.7 (0.1)	2.6 (0.5)	4.2	30.4
1 <sup>ary</sup> factor payments	9.1					
Taxes	3.8 (0.4)					
Imports	4.2					
Total Resource	30.4					

***The table is balanced  
 its numbers arguably look unsuspecting !***

2.6 of the 4.2 trillions of the exportations are in fact *intra-European flows*  
 ~ 62% of the exportations

***Overestimation of the economies' openness rates***

# A regional aggregation

**An EU27 IO table aggregated from GTAPAgg (in thousand billion 2004 USD)**  
 In parenthesis: expenditures or taxes on imported goods

	Intermediate Consumption	Consumption of households	Public consumption	Investment	Exports	Total Expenditure
Intermediate consumption	13.3 (2.7)	7.7 (1.3)	2.7 (0.1)	2.6 (0.5)	4.2	30.4
1 <sup>ary</sup> factor payments	9.1	Constructing an IO table <i>without correcting internal flows</i> → <b>Double counting</b> them both on the resource and expenditure sides.				
Taxes	3.8 (0.4)					
Imports	4.2					
Total Resource	30.4					

The export of a good from France to Germany → It is counted both:

- Expenditures
- As household consumption of imported good  
 (by the aggregation of the German household consumption data) (part of 1.3)
  - As an export  
 (by the aggregation of the French export data)

# A new aggregation procedure to correct the '*self-trade*' issue

a programme extending GTAPAgg which :

- Produces **automatically IO tables** in the SNA format (the standard United Nations format ); from the raw GTAP series; in csv format
  - **Corrects the 'self-trade' phenomenon**
    - Taking into account the **internal bilateral trade**, for any chosen aggregation level
    - Respecting the **accounting balance** for each production
    - Respecting the balance of expenditures and resources in terms of importations
- ( the sum of the imported goods' consumptions = imports, for each good)**

# Tackling the “self-trade” issue: A 5-steps process:

1

The “**self-trade**” shares of the *fob* imports and exports at world price **are subtracted** from their **raw aggregate totals**

The two shares amount to the same:

the exports of one region to itself equal its imports from itself.

For each good:

- The balance of expenditures and resources is not affected
- The balance of the imported variant is affected  
**Imports** on the resource side **become smaller** than the **consumption of imported goods** on the expenditure side.

# Tackling the “self-trade” issue: A 5-steps process:

2

## *On the resources side*

The “self-trade” shares of the **imports and exports taxes** are

- Subtracted
- Reallocated to a new tax category  
( assumed as border taxes internal to the aggregated region)

# Tackling the “self-trade” issue: A 5-steps process:

3

## *Still on the resources side*

A share of the taxes on the imported good consumption is reallocated to the taxes on the domestic good consumption



**Increases the unbalance** between resource and expenditure for the imported goods.

# Tackling the “self-trade” issue: A 5-steps process:

4

## *On the expenditure side*

A share of the **intermediate and final consumptions** of the imported variant of each good is reallocated to its domestic variant



**Restores** the resource-expenditure balance  
for the imported goods

# Tackling the “self-trade” issue: A 5-steps process:

For each region, the shares to be reallocated under **step 3 and 4** are identical :

$$\text{reallocated\_Share} = \frac{\text{Self\_impFOB} + \text{partSelf\_impTransp} + \text{Self\_impTax}}{\text{impFOB} + \text{impTransp} + \text{impTax}}$$

- = the aggregate share of the “self-trade” part in the sum of:
- imports FOB,
  - the transportation costs of international exchanges
  - import taxes

# Tackling the “self-trade” issue: A 5-steps process:

5

## *On the expenditure side*

A share of the exports of transportation services *specifically linked to international trade* is **reallocated** to the domestic intermediate consumption of transportation goods (goods 48, 49 and 50 of the database).

GTAP database does not identify what part of the “*self-import*” transportation is undertaken by business of the self-importing region



The **part reallocated** is set proportional to the participation of the region to these international activities

# Illustration of the “*self-trade*” correction

**An EU27 IO table aggregated from GTAPAgg**

	Intermediate Consumption	Consumption of households	Public consumption	Investment	Exports	Total Expenditure
Intermediate consumption	13.3 (2.7)	7.7 (1.3)	2.7 (0.1)	2.6 (0.5)	4.2	30.4
1 <sup>ary</sup> factor payments	9.1					
Taxes	3.8 (0.4)					
Imports	4.2					
Total Resource	30.4					

**2 different pictures of the European economy...  
With GDP unchanged**

**The “corrected” IO table**

	Intermediate Consumption	Consumption of households	Public consumption	Investment	Exports	Total Expenditure
Intermediate consumption	13.3 (1.1)	7.7 (0.5)	2.7 (0.0)	2.6 (0.2)	1.6	27.8
1 <sup>ary</sup> factor payments	9.1					
Taxes	3.8 (0.1)					
Imports	1.7					
Total Resource	27.8					

exclusively sum up the trade flows to and from regions outside the EU

Trade now amounts to much lower  
~ 12% of income (in stead of 32%)

The exposure of EU to international trade is reassessed quite lower than with the uncorrected data

# Concluding comments

- The programme correcting the «*self-trade*» issue is developed under **Scilab** (a freeware version of Matlab)
- The programme is **valid whatever the version of GTAP**
- This programme has already been used for the **calibration** of two **CGE models**:
  - *IMACLIM-S* (Ghersi et al., 2009)
  - *IMACLIM-R* (Sassi et al., 2010)
- **Next Step:**  
Illustrate the importance of the «*self-trade*» correction by comparing the conclusions of some policy analysis conducted either on the uncorrected, or on the corrected EU IO table.

**Thank you ...!!!**

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# Appendix

# An easy correction: The global IO table

	Intermediate Consumption	Consumption of households	Public consumption	Investment	Exports	Total Expenditure
Intermediate consumption	39.4 (6.8)	25.2 (2.8)	7.1 (0.2)	8.7 (1.4)	<del>10.5</del>	90.9
1 <sup>ary</sup> factor payments	32.5				0	80.4
Taxes	8.5 (0.7)					
Imports	10.5	0				
Total Resource	90.9	80.4				

- The aggregate import and export data can then simply be dropped.
- This is without consequence on the balance of the table since the two values match
- They strictly describe the same set of economic flows.
- Consequently the detail of the domestic or imported sources of expenditures and taxes can be ignored.

# A regional aggregation

**An EU27 IO table aggregated from GTAPAgg (in thousand billion 2004 USD)**

In parenthesis: expenditures or taxes on imported goods

	Intermediate Consumption	Consumption of households	Public consumption	Investment	Exports	Total Expenditure
Intermediate consumption	13.3 (2.7)	7.7 (1.3)	2.7 (0.1)	2.6 (0.5)	4.2	30.4
1 <sup>ary</sup> factor payments	9.1	<div style="border: 1px solid black; padding: 5px;"> <p>Constructing an IO table <i>without correcting internal flows</i>                      → <b>Double counting</b> them both on the resource and expenditure sides.</p> </div>				
Taxes	3.8 (0.4)					
Imports	4.2					
Total Resource	30.4					

The export of a good from France to Germany → The income source of this good is counted both:

- Resource**
- at the level of primary factors and taxes (by the aggregation of the French data)
  - and as an import (by the aggregation of the German data).

# Tackling the “self-trade” issue: Explanation for the step 5

- A region  $i$  is performing an amount  $m$  of the transport costs of a good  $j$ ,  
(costs that are related to ‘self trade’ importations of this good)
- We subtract this amount  $m$  from its total imports  
(in cost-insurance-freight, CIF, terms)
  - We then transfer it to the three transport intermediate consumptions of the production of the good  $j$
  - ➔ This transfer is done in proportion of their part in the total of the international transport operated by  $i$
  - We finally correct the expenditures by subtracting the same amounts from exports of these three transportation goods.

# Illustration of the correction

## Inermediate consumption matrix UE (\$2004)

		Moteur GTAP d'origine			Moteur Réctifié		
		E	Q	Total	E	Q	Total
Imp	E	2.03E+05	5.92E+04	2.62E+05	1.55E+05	4.53E+04	2.00E+05
	Q	2.31E+04	2.39E+06	2.41E+06	8.46E+03	8.76E+05	8.84E+05
	Total	2.26E+05	2.45E+06	2.67E+06	1.64E+05	9.21E+05	1.08E+06
Dom	E	1.37E+05	3.43E+05	4.80E+05	1.85E+05	3.57E+05	5.42E+05
	Q	1.13E+05	1.00E+07	1.01E+07	1.28E+05	1.15E+07	1.17E+07
	Total	2.50E+05	1.03E+07	1.06E+07	3.13E+05	1.19E+07	1.22E+07
<b>Total CI</b>		4.76E+05	1.28E+07	1.33E+07	4.76E+05	1.28E+07	1.33E+07

## Households consumption matrix UE (\$2004)

	Moteur GTAP d'origine			Moteur Réctifié		
	Imp	Dom	Total	Imp	Dom	Total
E	7.29E+04	3.28E+05	4.01E+05	5.58E+04	3.45E+05	4.01E+05
Q	1.18E+06	6.10E+06	7.28E+06	4.33E+05	6.85E+06	7.28E+06
Total	1.25E+06	6.43E+06	7.68E+06	4.89E+05	7.20E+06	7.68E+06

X2,6

*Les TES correspondants offrent une image très différente*