

# A TIMES PAN-EU/IMACLIM linkage (applied to EU28 electric vehicle penetration)

Frédéric Gherzi, CNRS

66th ETSAP conference, Copenhagen, Nov. 19th 2014

# Methodological context

- Historical opposition of *bottom-up* and *top-down* modelling of energy outlooks, **despite complementarities**
- **For simulation models** divergences are not so much conceptual than linked to **aggregation levels**...
- ...and to the extension of the *ceteris paribus* assumption
- How to connect TIMES PAN-EU to a standard CGE version of **IMACLIM** ?
- What preconditions on **data harmonisation**?

# Data harmonisation

## Hybridation of input-output tables

# Why hybrid IO tables?

- IO tables result from **data treatment** without particular attention to energy matters
  - To accommodate data from multiple non-harmonised sources
  - To switch from branch x branch to product x product logics
  - EU28: from IO at basic prices to IO at agents' prices
- IO tables trace **economic transactions** including commodity trading, not energy consumptions
- Energy **data on volumes and prices** is more focused and (presumably!) shared with BU modellers
- Energy price data highlights the importance of **abandoning the uniform pricing rule**

# IEA energy balance data treatment

- Non-E uses ignored
- Imports and exports corrected from self-trade (supplanted by COMEXT data anyway)
- Statistical errors spread over supply and demand
- Auto-consumptions and transfers vertically integrated
- **International bunkers** painstakingly split between imports and consumption of domestic agents
- **Transport consumptions** must be split between economic agents (inc. transportation services)

# Harmonisation process

- Substitution of IEA/ENERDATA **prices x volumes** to energy expenses, energy imports and exports of EUROSTAT IO tables **except households consumptions**
- Homothetic adjustment of all non-E resources of energy productions to restore uses/resources balance of energy products
- Systematic adjustment of the resources of the most aggregated non-E production to restore EUROSTAT totals of IC, C, G, I, X, L, K, M, T...

# Retained data

- EUROSTAT (inc. COMEXT)
  - Aggregated uses (all productions) CI, C, G, I, X  
... hence aggregated resources CI, L, K, T, M  
... hence aggregated VA (L+K) and GDP
  - International energy trade prices (€/TOE) and volumes (MTOE)
- IEA, ENERDATA, EUROSTAT
  - Volumes (MTOE) of energy consumptions of firms and households
  - Average prices (€/TOE) of energy consumptions of firms

# EUROSTAT vs. Hybrid table, EU28 2007

EUROSTAT	COMPOSITE	ENERGY	C	G	I	X	USES	
COMPOSITE	10 971	214	6 635	2 530	2 634	1 665	24 649	
ENERGY	664	497	483	2	2	70	1 717	
L	5 871	79	EUROSTAT IOT (processed)					
K	4 646	224						
T1	173	7						
M	1 381	286						
T2	943	411						
RESOURCES	24 649	1 717						

Hybrid	COMPOSITE	ENERGY	C	G	I	X	USES	
COMPOSITE	11 091	223	6 635	2 532	2 636	1 672	24 788	
ENERGY	676	356	483	-	-	63	1 578	
L	5 859	90	MTOE x €/TOE data (IEA, ENERDATA, EUROS) Exogenous assumption Homothetic adjustment to balance Remainder of EUROSTAT use/resource					
K	4 655	215						
T1	168	12						
M	1 331	336						
T2	1 008	347						
RESOURCES	24 788	1 578						



# Complementary step: Specific margins calibration

- Standard models based on **uniform pricing**  $\Rightarrow$  all agents face identical net-of-tax price vector
  - Contradicts the evidence of differentiated pricing
  - Strongly **biases** the balance of volume consumptions
- CIREN solution : calibration of **specific margins** to fall back on prices and volumes of E statistics
  - All energy consumer prices entail specific margins below or above the average cost structure
  - The specific margins of all agents balance out  $\Rightarrow$  no disequilibrium

# Hybrid table w. specific margins, EU28 2007

Hybrid	COMPOSITE	ENERGY	C	G	I	X	USES
COMPOSITE	11 091	223	6 635	2 532	2 636	1 672	24 788
ENERGY	676	356	483	-	-	63	1 578
L	5 859	90					
K	4 655	215					
T1	168	12					
M	1 331	336					
SM COMP	-	187 835					
SM ENER	-	-80 265					
SM C	-	-76 572					
SM X	-	-30 997					
T2	1 008	347					
RESOURCES	24 788	1 578					

MTOE x €/TOE data (IEA, ENERDATA, EUROS
Exogenous assumption
Homothetic adjustment to balance
Remainder of EUROSTAT use/resource
Calibrated to match €/TOE data

# The IMACLIM model and its linking to TIMES Pan EU

# IMACLIM at a glimpse

- CGEM with 2 primary factors **L** and **K**, **5 energy goods** and **6 non-E goods**
- **Recursive dynamics** driven by
  - Capital accumulation (exogenous depreciation; **stock!**)
  - Exogenous demography (EUROSTAT/EAPEP dataset by ILO)
  - **L** productivity, calibrated 2007/2013 then exogenous
  - **K** utilisation rate, statistical 2007/2013 then converges to historical average in 2020
  - Investment, statistical share of GDP 2007/2013 then converges to historical average in 2020
- Public expenses constant share of GDP
- Constant tax system, public budget balanced on households

# Calibration of 2007 to 2013 growth

- Capital stock calibration
  - Based on 2007 amortisement and investment and 2006 to 2007 growth...
  - ...Adjusted to 'make sense' acknowledging EUROSTAT data on utilisation rate and investment share of GDP
- Labour productivity calibration
  - Adjusted to match EUROSTAT GDP growth
  - Comes out stable through the crisis except -4% in 2010, -2% in 2011 ⇒ still improvable

# Behavioural assumptions

- Productions : sequential trade-offs  $K$  vs.  $L$  then  $KL$  vs.  $E$  then  $KLE$  vs. ' $M$ ' (**Leontief** aggregate of non-E goods)
  - **CES functions** for  $K$  vs.  $L$ ,  $KLE$  vs. non-E,
  - Imported from **TIMES PAN-EU** for  $KL$  (VA) vs.  $E$  under a **maintained CES assumption** for  $KLE$
- Households trade-offs **imported from TIMES PAN-EU** by forcing 5 E goods, EV consumption,
- International trade
  - Imports follow Armington hypothesis (CES)...
  - ...Except coal, oil, gas imports balance consumption and production imported from **TIMES Pan-EU**
  - Exports elastic to terms of trade around an exogenous time trend

# Iterative linking to TIMES Pan-EU

- Pan EU-TIMES Output / IMACLIM Input: **time paths of**
  - Primary productions of **oil, coal, gas**
  - Household consumptions: **5 E** goods in MTOE, conv. and electric **vehicle units, pkm** of land, water, air (public) transport
  - **Intensity in 1 to 5 energy vectors** of electricity, automobile industry, electric equip. industry, land, sea and air transport
  - Intensity in electronic equipment of the automobile industry
  - €/TOE **import prices** of oil, coal, gas and refined products
- Output IMACLIM / Input TIMES Pan EU: **time paths of**
  - GDP, activity indicators?, primary and secondary factors prices?

# Pending issues

- Pervasive **nomenclature** issues
  - Transports: households vs. firms consumptions in TIMES Pan-EU? Conversely, freight vs. passenger transport in IMACLIM?
  - Biomass: aggregated to refined products in IMACLIM
  - Decentralised electricity production
- **Control of production costs** of energy vectors
  - Renounce  $K$  vs.  $L$  CES to exogenise  $K$  intensity of electricity for sure, of refined products? What about coal, oil, gas production?
  - O&M costs i.e.  $L$ , non- $E$  intensities of production?
- Resilience of **growth model** w. perfect factor markets
- Relevance of **nested CES** structure?



# Preliminary output of a reference case

