



Calibrating Supply-side driven structural changes in CGE baseline

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Introduction: Structural Changes in CGE models baseline



What Structural Changes in CGE models baseline (I) ?

- By structural changes we mean a change in the way agent decision are changing, production processes are shifting, change in market functioning,... technically in the model any change in functional forms or equations parameters.
- Structural changes matter for long-run issues.
- Of course even with no additional assumption running the model would involve some “endogenous” structural changes. But these session is about “controlling this structural changes towards some desired outcomes?
- THE OBJECTIVE OF THE PAPER IS TO PRESENT THE CHOICES MADE BY VARIOUS MODELLING TEAMS TO “CONTROL” THE PROJECTED STRUCTURAL CHANGES TOWARD SOME DESIRED OUTCOME.
- In other words: Is there consensus about some future structural changes features? How they are reached?
- The Modelling Teams studied are those present at the GTAP-OECD workshop held in January 2018 at Paris OECD headquarters : around 27 Teams, some using same model but with different specifications.



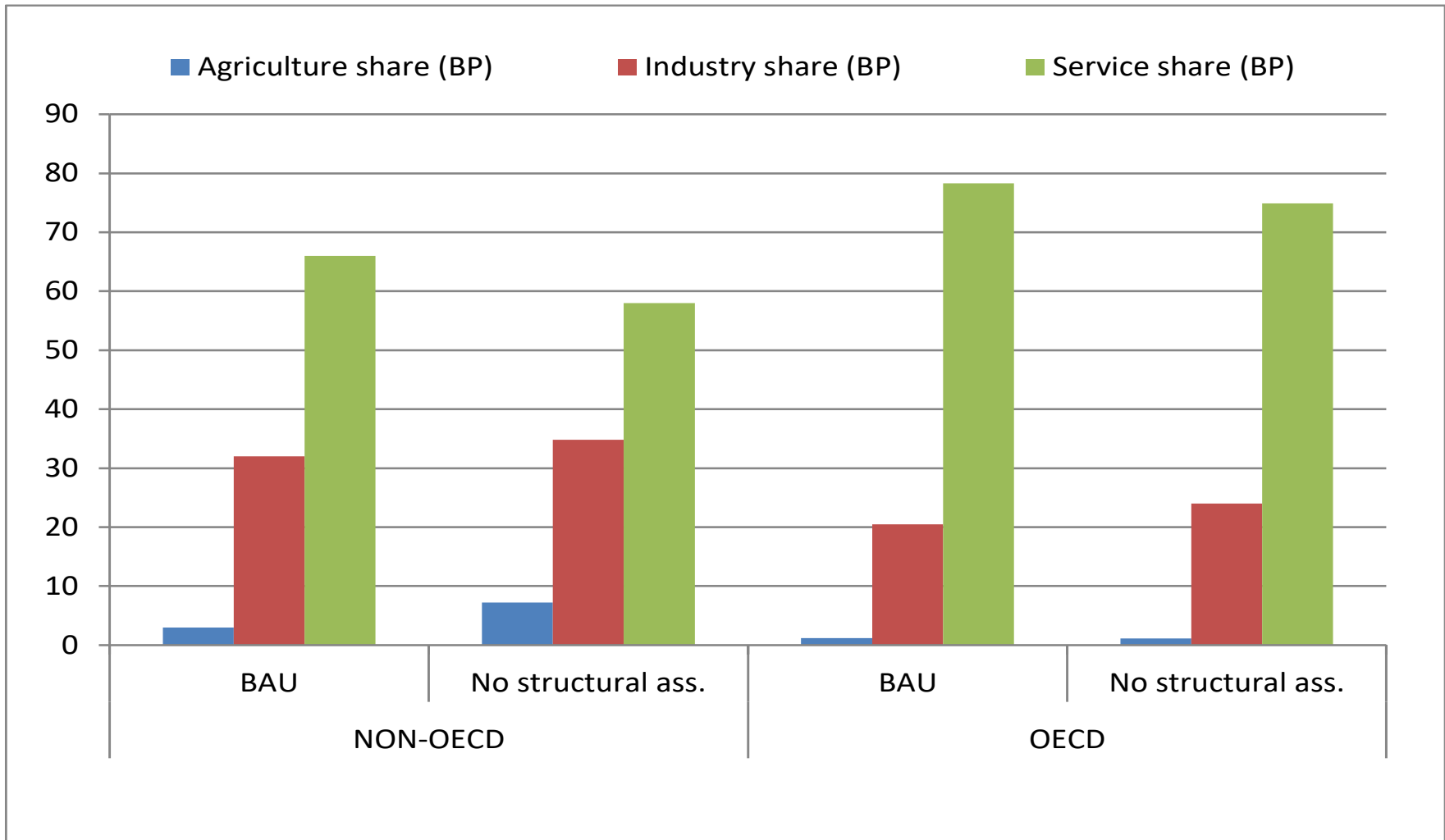
What are Structural Changes in CGE models baseline (II) ?

The paper deals with structural change involved by change in production modes (and not driven by changes in final demand patterns) :

- changes in production modes and technologies during the baseline horizon:
 - Changes in factor efficiency / sectoral TFP
 - Natural Resources shifter
- Changes in the intermediate demand patterns:
 - Changes in intermediary demands (I-O coefficient structures): Exple shift towards more services inputs
 - Changes in efficiency of some goods: Exple changes in fertilizer efficiency in agriculture
- Apparition of new needs/goods or new technologies / changes in the nature of goods.
- Environmental Damages : example climate change will change crops yield efficiency
- Changes in trade patterns (side topic)



A very simple exercise with ENV-Linkages : BAU with or without Structural changes assumptions (2050): experiment





Session : Changes in primary factor efficiency



Technically structural changes are seen as changes in transformation function of production

- Standard $VA = TFP \cdot F(\lambda_K K, \lambda_L L, \lambda_{NR} NR, \lambda_{LAND} LD)$
- Gross Output:

$$X = F(TFP \lambda_K K, \lambda_L TFP L, \lambda_{NR} TFP NR, \lambda_{ID(i)}, \lambda_{LAND} TFP LD, ID(i) \dots \lambda_{ID(j)} \cdot ID(j))$$

- Focus here is **changes in efficiency variables λ_{PF}** of the primary factors ($PF = K, L, Land, NR$), including common Total Factor Productivity (**TFP**)
- Dynamics of the primary factors variables K, L, NR
- changes in intermediate demands efficiency $\lambda_{ID(i)}$
Discussed in second part of the presentation.
- Logically these also include the changes in Autonomous Energy efficiency ($\lambda_{e(ei)}$), but discussed here because in most models energy bundle is generally nested closely with primary factors.



General approach

- In the baseline construction λ_{PF} is :
 - either exogenous, based on literature or external estimation
 - Endogenous => to match some target, a “variable” of the model that is endogenous in “variant” mode is exogenous in “calibration” mode. The target could be an economic variable (labour demand, production,...) or a ratio (energy intensity, labour productivity,...)
- The calibration could be (or not)
 - sectoral-specific
 - region-specific,
 - time-specific



Default approach by most teams (1.)

- No Team seems to use EXOGENOUS TFP or Labour efficiency (Labour Augmenting TP) scenarios and let the GDP being endogenous in the baseline.
- GDP are targeted with Aggregate Labour Productivity: incidence of this choice?
 - Few teams use TFP instead
 - Most of the team uses differentiated sectoral productivity:
 - generally only Serv vs Ag vs Indus and same wedge for all country
 - Some teams use more specific sector and regional differences in Labour Productivity
 - Does other team than ENV-Linkages make some convergence assumption about sectoral productivity?



Default approach by most teams (2.)

- Most of the teams use exogenous land efficiency from external sources by crops and regions, unclear if it is projections
- Some team use sector-specific TFP in crop sectors to reproduce either output or yields obtained from external projections.
- Natural resources efficiency are constant
- Capital efficiency are generally constants:
 - Few teams use capital efficiency to target capital to labour ratio (Dominique?) or aggregate labour income share to GDP (OECD)



Default approach by most teams (3.)

- It seems that no teams assume nothing on fertilizer efficiency...
- ... but most teams use external assumptions/scenarios for feed efficiency: why this difference?
- Most teams uses exogenous AEEI assumptions:
 - Generally very ad-hoc : 1% annual growth
 - Other teams use sector/energy carrier specific exogenous assumptions
 - Only few teams will entirely calibrate energy efficiency (e.g. endogenous) on external exogenous projections. In this case the targets are either energy demands projections or energy intensities scenarios.

⇒ Apply same efficiency improvement for diff. carrier/sector that have different elasticities is strange: $e(i) = a(i) \lambda_e(i)^{(\sigma_e-1)} E (P_E/P_e(i))^{\sigma_e}$
- Calibration of Technological Mix in Power sectors for next session.



Data requirements and empirical validation

- Evidences for some efficiency trends are scarce (fertilizer efficiency) or not very accurate (capital efficiency) and not easy to import in a different model (see next slide).
- Best practice is probably to resort to external set of projections from partial equilibrium models for example: energy-system projections (IEA, POLES,...) or agriculture projections (IFPRI, OECD-FAO, FAO, GLOBIOM) and then make efficiency endogenous to match these projections
- Because the practice consisting in using exogenous efficiency from external studies (yield, aeei) is problematic because factor efficiency should be model dependent when elasticities of substitution differ to one. This is also the reason why people do not use directly TFP or Labour efficiency from Growth Models and let GDP endogenous.



Other Common bottlenecks and Recommendations for research efforts

- Only few models really calibrate or take into account primary materials (NatRes) efficiency in “OMN”, “FRS” and “FSH”.
- Endogenous Efficiency : almost all efficiency improvement discussed before are “no-cost technical change” (excepted a small effort on aeei, and TFP in ag for some Teams). So could we add this: like linking human capital and education expenses, add R&D sector,...
- In the case of endogenous efficiency in the baseline to reproduce exogenous projection demand of labour, energy,... one should be careful that these projections uses at least same macro and policy assumptions
- Improve way of calibrate exogenous projections by endogenously adjusting efficiency (insure common scenarios in both model)
- For model with vintage: reflexion on vintages specific efficiency parameter



Changes in input-output (and Trade) nesting



Changes in intermediary demands

- Intermediate demands for some goods are controlled or calibrated (agr., food, energy) but generally nothing is done for other sectors.
- Very few teams would control “services input demands by firms” but this is critical a critical issue if one wants to increase the share of services beyond the usual increase of the share of services in final demands with income per capita. Here we deal with actual transformation of economies towards:
 - 1) the *servitization* of industries
 - 2) “digitalization”
- Lack of evidence of these structural changes in intermediate consumption, ad-hoc manipulation in general.



Changes in technologies in Power Sectors

- Most teams adopt multiple technology for electricity generation
- In the baseline future changes in POWER mix is either ad-hoc (non-prices movements in CES-shares increase for renewable-electricity / CES-coefficient or Logit) or endogenous to reproduce external projection (IEA/POLES). The status of the difference about cost of electricity generation is unclear in this calibration process.
- Most teams control demand for electricity/renewables and fossil-fuel in transportation (and households), but not very transparent.
- Some teams also assume the possible apparition of “advanced POWER technology” (included CCS) but no energy backstops seem to be in the baseline, despite that some models projects increase in advanced technology either exogenously or through learning-curve



Other structural changes drivers

- Policy Changes, generally most baselines do not put policies in their model, but some team will put some policy elements (EU-ETS for carbon prices) or calibrate some prices trajectories that implicitly embodied policies (energy prices)
- Environmental damages feedbacks imply structural changes:
 - Climate Change,
 - Air Pollution,
 - Water scarcity



Change in international Trade Patterns (May be not this session)

Most of the teams use Armington specifications, 4 elements can be used to correct the trade patterns during the baseline projections:

1. International Trade and Transport cost:
 - generally most Team use either ad-hoc exogenous assumption about changes in these costs
 - Some teams do some scenarios for these costs
2. Armington Shares generally not constant
 - Some teams changes these in ad-hoc way to for example imply increase of the trade of services
 - Some teams do adjustment to reproduce???
3. Iceberg Costs or Second level armington shares:
 - The majority of the team does not consider any changes here
 - Some teams do ad-hoc changes to imply an increasing share of non-OECD countries in global trade
4. Trade policies: NOT in the baseline for the majority of teams (CEPII?)



Common bottlenecks

- Projections of some very important sectors are not “controlled” or calibrated : for Agriculture most Team seem to doing fine agric food mostly driven by food demand (& textile) but for energy this is problematic, how energy demands could be accurate if projections of energy intensive industries(steel,cement) are not consistent, and one step up if construction & vehicles demands are not accurate.
- Empirical validation is generally weak : checking share of services/ag/industry and it is all (personal impression).
- Clear recommendation: do not use external projections of sectoral demands that have been generated with a model using a different baseline. How to harmonize? Maybe use intensity or ratios as targets instead of absolute values.
- Some changes that are not handle in almost all models: changes in market functioning