Endogenous Labour Supply in CGE-Household Micro-Simulation-Top-Down/Bottom Up Model

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- Objective and a brief history of CGE modeling
- CGE modeling with labour supply
- Magnac labour supply model (1991)
  - Main characteristics
  - The econometric model
- CGE-TD/BU model applied to the Philippines
  - Macroeconomic results
  - Effects on poverty for the whole population and by education groups
  - Comparative Growth Incidence Curves for population
- Conclusion and to follow up the thinking

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- Use of a new approach to model macro-micro linkages to analyse impacts of policies/external shocks on poverty and income distribution
- Introduce a labour supply with unemployment (regime switching) for poverty analysis
- Introduce endogenous labour supply

- As previously presented: Three types of approaches
  - Representative households (RH approach)
  - Integrated Multi-household approach (IMH approach)
  - Macro-micro-simulation (CGE-MS approach)

CGE-TD/BU approach

Linking the CGE model to a household (HHMS) model (Top-down) and the HHMS model to the CGE model (Bottom-Up) until a converging solution is found

- Pros.
  - Allows rich micro-behaviour
  - Allows intra-group distributional analysis
  - Removes the group choice constraint
  - Takes into account micro-household feedback effects in the CGE model
  - Provides macro coherence framework
  - No need to have a consistency between micro and macro data
  - No limit to the level of disaggregation (production sectors and number of HH)
- Cons.
  - Data and technically intensive

Top Module: CGE

Exogenous: (*Consumption,C,* ***Labor supply, L****)*
Endogenous and output to HHMS: (*p, w)*

Loop until
$\|\Delta C, \Delta L\| \leq \varepsilon$

Bottom module: household micro-simulation (HHMS)

Exogenous (*p, w*)
Endogenous (Y_h, C_h, L_h,)
Output to CGE (*Total Consumption,C,* ***Total Labor supply,L****)*

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- Applications of CGE-RH approach:
  - Fortin, Marceau and Savard (1997)
  - Savard and Adjovi (1998)
  - Devarajan, Ghanem and Thierfelder (1999)
  - Agenor, Izquierdo and Fofack (2003)
- According to our knowledge, no application with Integrated Multi-household approach
- Applications of CGE-MS approach:
  - Bourguignon, Robilliard and Robinson (2002)
  - Bussolo and Lay (2003)
  - As seen in other presentations
- CGE-TD/BU $\Rightarrow$ An illustration in this presentation of Savard's version

- Fixed formal wage, excess supply of labour
  - The supply of labour is based on the potential wage estimated from the Magnac model
    - This potential wage takes into account the cost of entry into the formal sector
    - Hiring (most skilled from unemployed and informal sector)
    - Fired (least qualified of the formal sector)
- Informal sector labour supply
  - Based on the reservation wage calculated from the estimation of the Magnac model
    - Work if reservation wage is below prevailing wage
    - Unemployed if reservation wage is above

- The potential wage ω_h^j of individual *h* in the segment *j* (1=formal and 2= informal) of the labour market is given by:

$$\omega_h^j = \pi_h . w^j \tag{1}$$

with

$$ln\pi_h = H_h . \gamma^j + u_h^j \tag{2}$$

where

- w^j is the general level of earnings in segment *j* (solution of the aggregate CGE model)
- H_h are the human capital characteristics of worker *h*
- γ^j is a vector of coeff. specific of segment *j* and
- u_h^j is the residual term for the effect of unobserved characteristics on worker productivity in *j*

- Participation decisions are taken by comparing the potential wage on both segments to a reservation wage ω_h^0:

$$ln\omega_h^0 = H_h.\gamma^0 + Z_h.\delta + u_h^0 \quad (3)$$

where

- γ^0 are the elasticities of the reservation wage with respect to the observable characteristics of workers
- δ are the elasticities of the reservation wage with respect to the household characteristics and
- Z_h and u_h^0 summarize the effect of unobserved variables

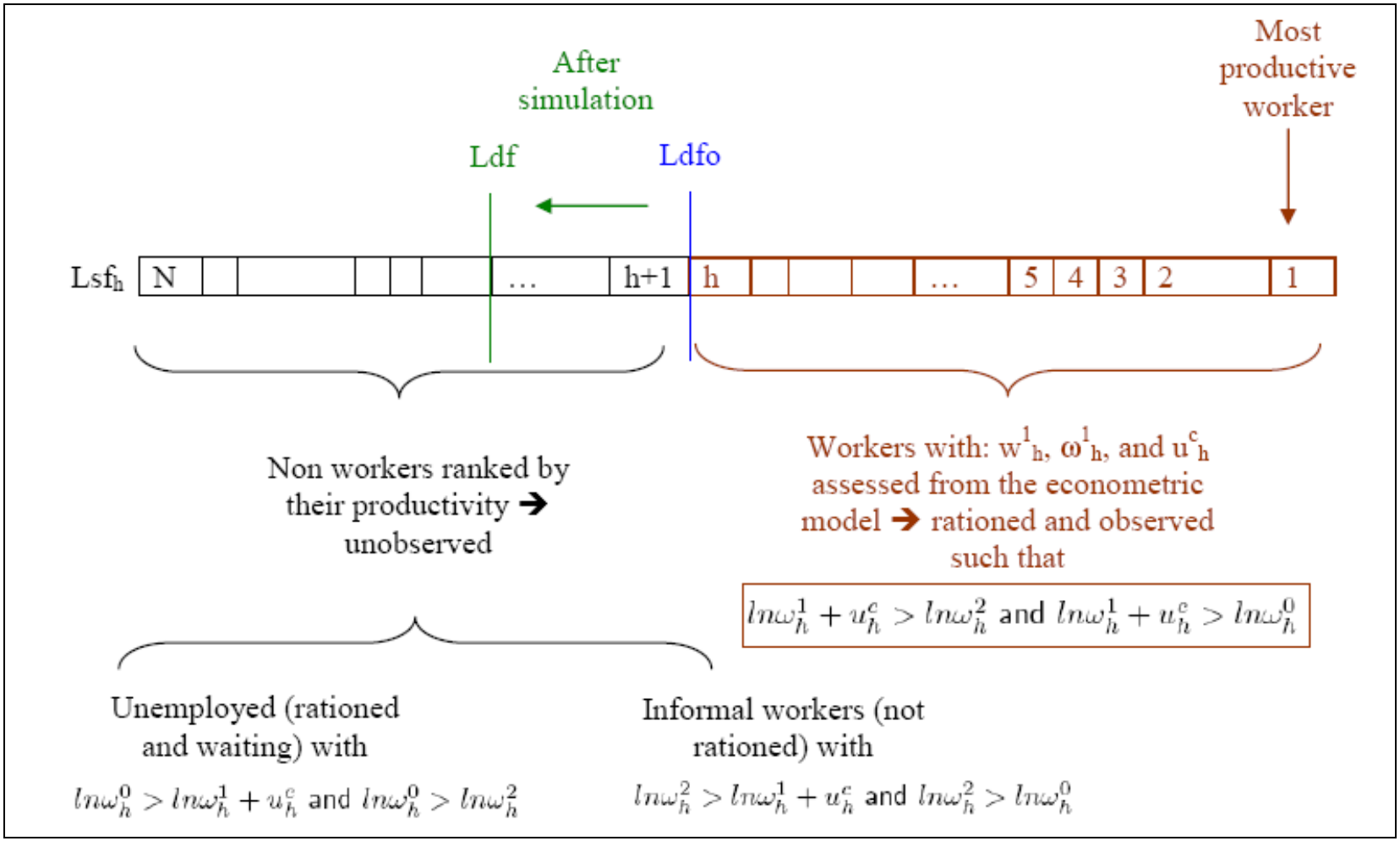
As ω_h^0 is not directly observed and must be inferred from the observed participation behaviour of individuals

- Decision process of an individual who has to choose among three alternatives (Roy's model):
  - Being unemployed
  - Working in formal sector or
  - Working in informal sector
- Imperfection of the labor market and entry restrictions in formal sector are got by a cost of entry in that sector. Then the net gain in the formal segment is defined as:

$$ln\omega_h^1 + u_h^c \tag{4}$$

where u_h^c stands for the proportion of earnings in formal sector received by the worker after taking into account the cost of entry

- The employment decision process can be described by the following set of conditions:
  - Formal employment: $ln\omega_h^1 + u_h^c > ln\omega_h^2$ and $ln\omega_h^1 + u_h^c > ln\omega_h^0$
  - Informal employment: $ln\omega_h^2 > ln\omega_h^1 + u_h^c$ and $ln\omega_h^2 > ln\omega_h^0$
  - Unemployed: $ln\omega_h^0 > ln\omega_h^1 + u_h^c$ and $ln\omega_h^0 > ln\omega_h^2$
- Under the assumption of a normal distribution of the unobserved terms, the model could be estimated by different ML methods:
  - Generalized bivariate Tobit (Amemiya, 1985)
  - In two steps (Heckman, 1979): 1- Bivariate probit (participation and choice sector) or univariate probit (participation) and 2- OLS on wage equations with Mill's ratio


After simulation
Ldf
Ldfo
Most productive worker
Lsf_h
N
…
h+1
h
…
5
4
3
2
1
Non workers ranked by their productivity ➔ unobserved
Workers with: w^1_h, ω^1_h, and u^c_h assessed from the econometric model ➔ rationed and observed such that
$ln\omega_h^1 + u_h^c > ln\omega_h^2$ and $ln\omega_h^1 + u_h^c > ln\omega_h^0$
Unemployed (rationed and waiting) with
$ln\omega_h^0 > ln\omega_h^1 + u_h^c$ and $ln\omega_h^0 > ln\omega_h^2$
Informal workers (not rationed) with
$ln\omega_h^2 > ln\omega_h^1 + u_h^c$ and $ln\omega_h^2 > ln\omega_h^0$

- Standard CGE model: EXTER model from Decaluwé, Martens and Savard (2001)
  - 20 production branches
  - HH consumption modeled with a LES based on consumption expenditures
  - Fixed capital in production branches
  - Small country: Armington assumption
- Contribution
  - Segmented labour market such as Magnac (1991) with functions mimicking the labour supply behaviour of the HHMS model

- Data used for the Household model/Labour supply estimation (Bottom part)
  - 39,520 households of the FIES 1997 survey
  - Income and expenditure structures taken exactly from FIES
  - Labour supply (Magnac, 1991) assessed as Heckman and Sedlecek (1985)
    - Modern/formal labour market: rationed by fixed wage
    - Informal sector with flexible wage
    - Unemployment (rationed and waiting)
  - Used data from LFS (three passages combined with FIES (at 98%) for 1997)

- Simulation : An across-the board reduction in import duties of 30%
  - The Philippines are a rather open economy;
  - Such a reform entails some restructuring of the economy implying
    - effects on price system and
    - on distribution of welfare
  - Popular reform in 90's
- The simulation is performed under two specifications:
  - Real wage fixed and TD/BU specification
  - Real wage fixed but ignoring the feedback effects from the microsimulation to the macro (TD specification)

Variables	Base	TD/BU_FX_w[1]	TD_FX_w[1]
Gross domestic product	104,510	-0.69%	-1.27%
Real Household income	86,476	1.13%	0.64%
Household real consumption	72,607	1.40%	1.03%
Formal Wage (index)	1	-	-
Informal Wage (vs formal)	0.5	-1.25%	-0.46%
Government income	20,367	-8.43%	-8.84%
Real public spending	16,818	-11.34%	-13.02%
Real investment	23,684	2.26%	2.17%
Firms' income	26,172	0.55%	0.14%
Firms' savings	7,810	0.95%	0.24%
Employment rate	0.8316	-0.66%	-2.03%
Exchange rate (index)	1	0.30%	0.27%

TD/BU_FX_w[1]: TD/BU model with fixed formal wage
TD_FX_w[1]: TD model with fixed formal wage

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Poverty Index	Groups	Base	TD/BU_FX_w[1]	TD_FX_w[1]
FGT_0	**Philippines**	0.311	-1.46%	-1.79%
FGT_0	Not reported or no grade	0.564	-1.48%	-1.55%
	Elementary undergraduate	0.501	-1.38%	-1.58%
	Elementary graduate	0.384	-0.81%	-1.25%
	One to three years of HS	0.317	-2.11%	-2.45%
	HS graduate	0.184	-3.08%	-3.28%
	College undergraduate	0.092	-0.34%	-2.06%
	At least college graduate	0.021	-1.96%	-3.42%

TD/BU_FX_w[1]: TD/BU model with fixed formal wage
TD_FX_w[1]: TD model with fixed formal wage

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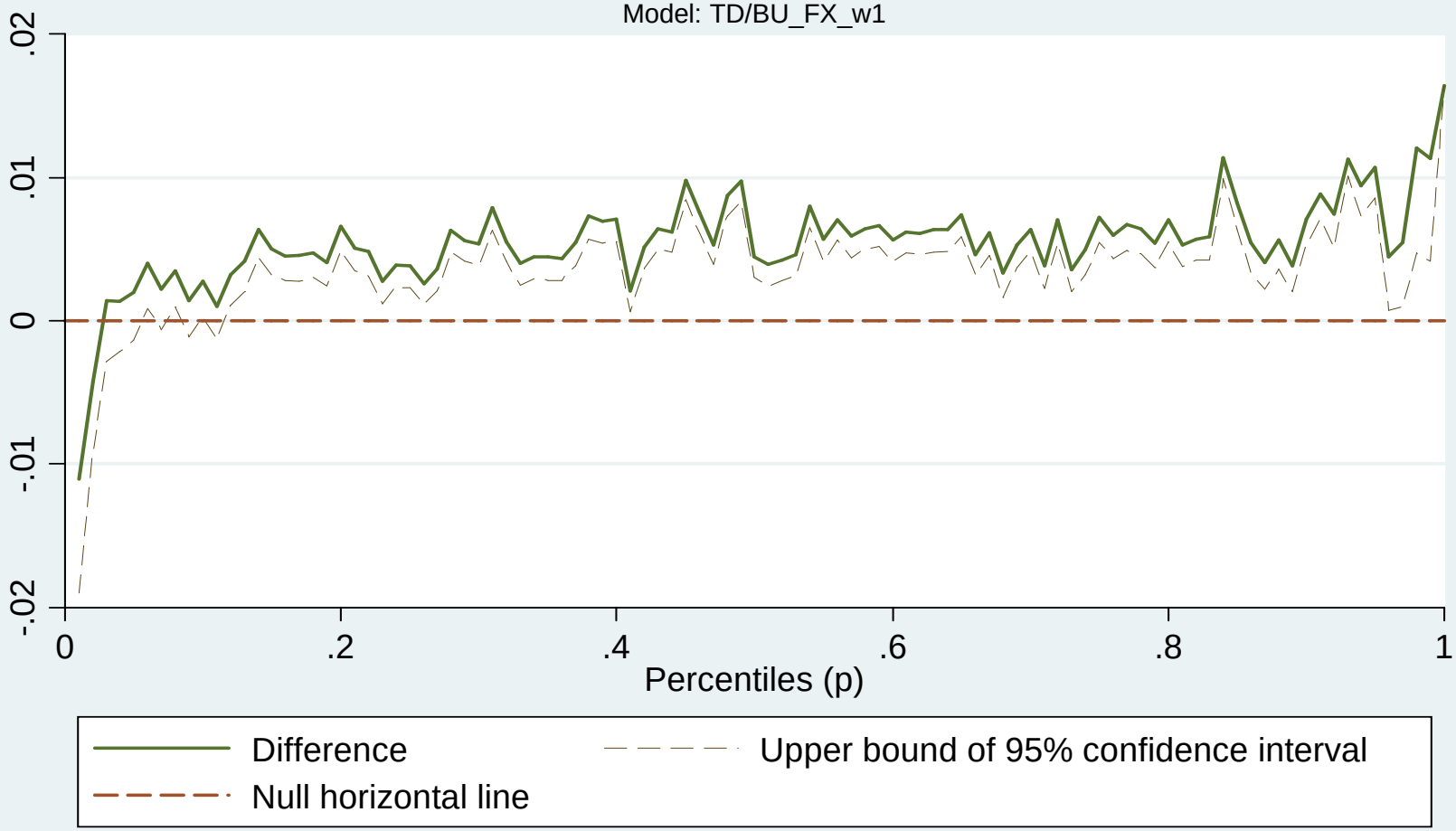
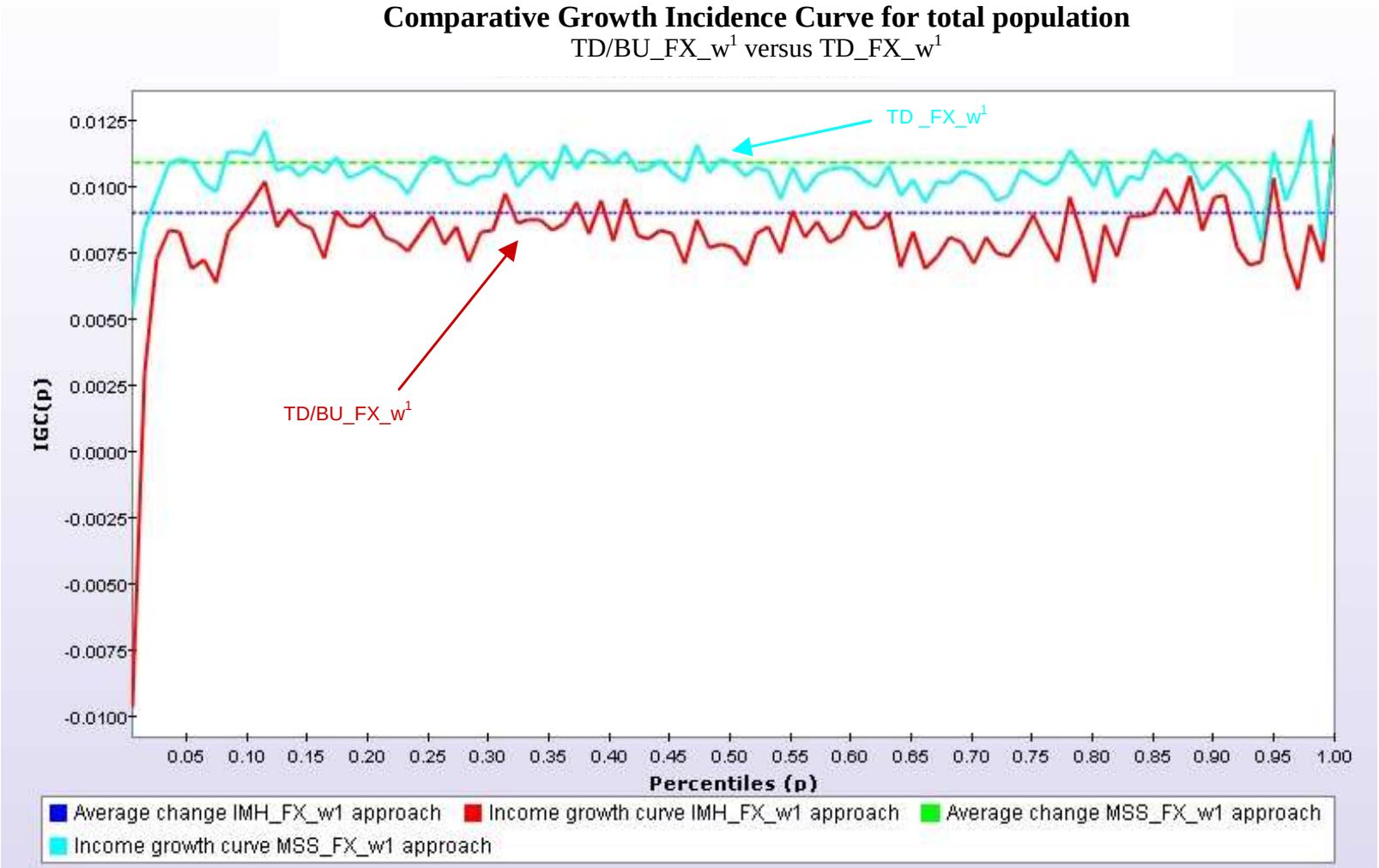

Growth Incidence Curve for total population
Model: TD/BU_FX_w1
.02
.01
0
-.01
-.02
0
.2
.4
.6
.8
1
Percentiles (p)
Difference
Upper bound of 95% confidence interval
Null horizontal line



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- Taking into account the micro consequences of a macro policy through the integration of a micro data base of HH within a CGE model. Two ways:
  - through a conventional CGE-MS approach without any feedback at the macro level (TD-CGE)
  - through iterations between those two modules with a TD/BU-CGE model
- Differences between the two approaches in the presence of rigidities in the labor market (rationing situation):
  - TD-CGE model tends to overestimate the negative impact on GDP and employment $\Rightarrow$ to underestimate effects on reducing poverty
  - Differences between the two models are higher with a fixed formal wage

- Further work:
  - Testing the limits or possible sources of non-convergence
  - Applying with other micro-modeling such as
    - Almost Ideal demand system (to follow)
    - Agriculture household modeling
    - Gender issues