Introducing an Almost Ideal Demand System (AIDS) in a CGE microsimulation model

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Objective of the application

- Introduce more heterogeneity in household behaviour
- Explore the contribution of the AIDS demand system in a CGE-TD/BU microsimulation context for distributional analysis

Why should we introduce the AIDS

- Proposed by Deaton and Muelbaeur (1980)
- Much richer compared to standard functions used in CGE modeling (C-D, LES)
  - minimal consumption and
  - differentiated cross price elasticities
- Income and price elasticities are household specific
- Distributional analysis should be improved

Why should we introduce the AIDS

- From Price Independent Generalized Logarithmic Function : *c(p,u)*

$$\log c(u,p) = \alpha_0 + \sum_k \alpha_k \log p_k + \frac{1}{2}\sum_k \sum_j \gamma^*_{kj} \log p_k \log p_j + u\beta_0 \prod_k p_k^{\beta_k}$$

- With Shephard lemma and some manipulations we obtain the following expenditure shares:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log\left(\frac{X}{P}\right)$$

- And its associated price index is:

$$\log P = \alpha_0 + \sum_k \alpha_k \log p_k + \frac{1}{2}\sum_k \sum_j \gamma^*_{kj} \log p_k \log p_j$$

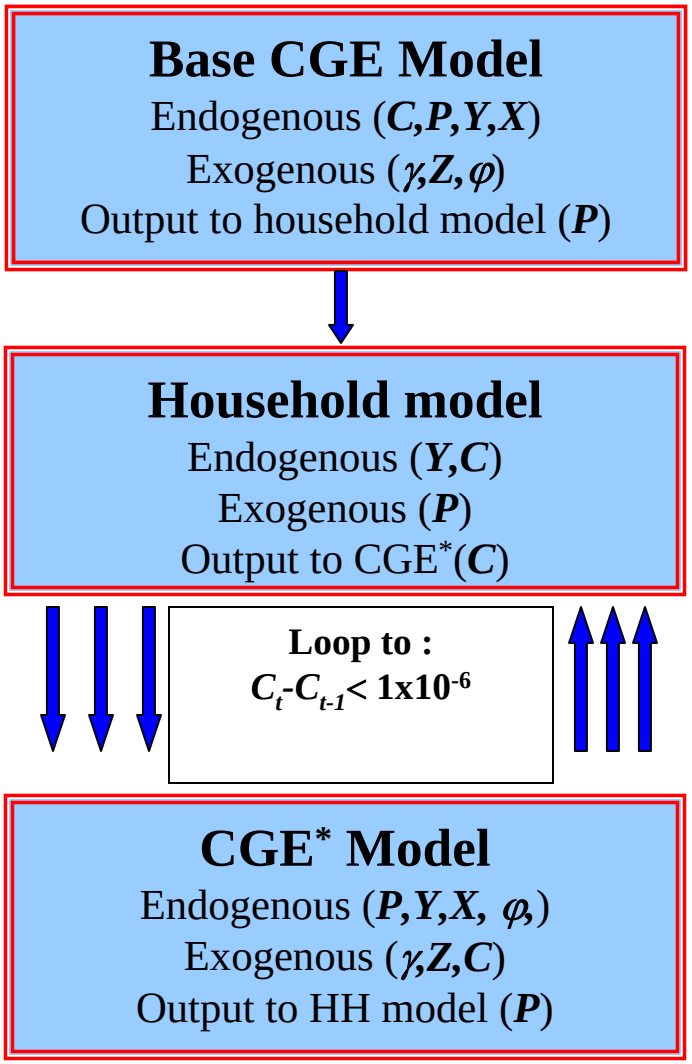
CGE application to the Philippines

- CGE relatively standard
  - Starting point : EXTER model of Decaluwé, Martens & Savard 2001.
  - 20 branches
  - Perfectly segmented labour market (formal et informal)
  - Introduce an AIDS

Household model

- 39 520 households from 1997 FIES.
- Keep the structure of survey as a starting point.
- Income, is determined with endowment from survey and variation of wages from CGE model
- AIDS is used for demand.
- Expenditure shares drawn from survey and price changes are imported from CGE model
- Same behavioural functions for households in the two models

Links


Base CGE Model
Endogenous (C,P,Y,X)
Exogenous (γ,Z,φ)
Output to household model (P)
Household model
Endogenous (Y,C)
Exogenous (P)
Output to CGE*(C)
Loop to :
C_t-C_{t-1}< 1x10^{-6}
CGE* Model
Endogenous (P,Y,X, φ,)
Exogenous (γ,Z,C)
Output to HH model (P)

The AIDS !!

- In a standard fashion we selected γ_{ij} and βi from the literature and calibrated α_{ih}
- We intended to estimate for sub-groups but…
- We replaced this price index by the Stone index (we will see why)

$$w_{i,h} = \alpha_{i,h} + \sum_j \gamma_{ij} \log p_j + \beta_i \log\left(\frac{X_h}{P}\right)$$

$$\log P_{Stone} = \sum_i \bar{\phi}_i \log p_i$$

Non convergence !!

- We could not converge the model
- Why did we get this non convergence??
  - w_{hi}=0 of reference become w_{hi} ‹ 0 for 10% of households.
  - Extreme sensitivity of the AIDS price index
  - Size and impact of error term of calibration process (or α_{ih}).
  - Sensitivity of elasticities selected (γ_{ij})

Non convergence !!

- Solutions
  - Replace the price index by the Stone price index as suggested in Deaton and Muelbaeur (1981)
  - Correction factor for negative shares.
  - Reduce sensitivity of (γ_{ij})
  - Introduce identical (or α_{ih}) and add an error term
  - Constrain the error terms to sum to 0 (aggregation will eliminate this term)
- These solutions were insufficient.
- Lets see why!

Non convergence (suite)

$$w_{ih} = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log\left(\frac{x_h}{P}\right) + e_{ih}$$

$$q_{ih} = \frac{\alpha_i x_h}{p_i} + \frac{x_h \sum_j \gamma_{ij} \log p_j}{p_i} + \frac{x_h \beta_i \log\left(\frac{x_h}{P}\right)}{p_i} + \frac{x_h e_{ih}}{p_i}$$

$$Q_i = \frac{\alpha_i X}{p_i} + \frac{X \sum_j \gamma_{ij} \log p_j}{p_i} + \frac{X \beta_i \sum_h \log\left(\frac{x_h}{P}\right)}{p_i} + \frac{\sum_h x_h e_{ih}}{p_i}$$

Non-convergence (suite)

HH Model equation after aggregation of all households →

$$Q_i = \frac{\alpha_i X}{p_i} + \frac{X \sum_j \gamma_{ij} \log p_j}{p_i} + \frac{X \beta_i \sum_h \log\left(\frac{x_h}{P}\right)}{p_i} + \sum_h e_{ih}$$

We impose $\sum_h e_{ih} = 0$

CGE equation for aggregate household →

$$Q_i = \frac{\alpha_i X}{p_i} + \frac{X \sum_j \gamma_{ij} \log p_j}{p_i} + \frac{X \beta_i \sum_h \log\left(\frac{X}{P}\right)}{p_i}$$

$$\sum_h \log\left(\frac{X_h}{P}\right) \neq \log\left(\frac{X}{P}\right)$$

Non convergence

- Interestingly, the difference between the two terms is an inequality index: Average logarithmic gap (Atkinson and Bourguignon 2000)

$$ALG = \log\left(\frac{X}{P}\right) - \sum_h \log\left(\frac{X_h}{P}\right)$$

Solution to non convergence

- Integrate the income equation for all households (39 520) in the CGE model.
- Substitute the aggregate demand of the CGE model by the aggregate demand of the household model into the CGE model.
- By adding only this equation for the households, we increase the number of equations by 39 520 equations instead of 900 000 required in the fully IMH approach.

Simulation

- To illustrate de contribution of the AIDS we performed a 30% uniform reduction of import duties

Macro results

Variables	Definition	Reference	TD/BU (LES)	RA (AIDS)	TD/BU* (AIDS)
Ym	Aggregate Household income	86,48	**-0,27**	**-0,28**	**-0,24**
Yg	Government income	20,37	**-8,29**	**-9,08**	**-8,89**
Ye	Firm's income	26,17	**0,76**	**0,58**	**0,51**
Sg	Public savings	-1,16	**7,15**	**8,97**	**11,89**
w^1	Formal wage	1	**-3,95**	**-3,63**	**-2,9**
w^2	Informal wage	0,5	**0,66**	**0,99**	**0,65**
e	Nominal exchange rate	1	**0,21**	**0,33**	**0,73**
GDP	Gross domestic product	104,51	**-0,05**	**-0,24**	**-0,23**

Sectoral results

Variables	branches	Reference	TD/BU (LES)	AR (AIDS)	TD/BU* (AIDS)
Pq (Market prices)	Paley & corn	1,01	1,85	-0,97	0,47
	Fruits & vegetables	1,02	0,48	0,32	-0,85
	coconut products	1,02	0,74	0,9	0,77
	Livestock	1,01	0,36	-1	-1,61
	Fishing	1,01	0,68	0,47	-0,61
	Other agriculture	1,02	-1,06	-1,36	-0,95
	Forestry and wook	1,01	0,42	-1,54	-1,34
	Mines	1,01	-0,24	-0,1	0,33
	Manufacturing	1,08	-3,73	-3,55	-3,12
	Rice industries	1.00	1,17	-0,79	0,35
	Meat industries	1,01	0,1	-0,24	-0,96
	Food indutries	1,03	-0,99	-1	-1,32
	Water-Electricity & Gas	1,01	-3,09	-2,67	-1,84
	Construction	1,01	-1,33	-1,11	-1,15
	Commerce	1,05	-1,09	-0,85	-0,37
	Transport. & comm.	1,01	-1,13	-0,61	-0,85
	Finance	1,05	-2,01	-2,07	-1,67
	Real estate	1.00	-2,39	-2,27	-1,93
	Services	1,04	-1,69	-1,12	-1,43
	Public services	1.00	-2,35	-2,05	-1,74

Poverty analysis : poverty headcount variations (FGT_0)

	Code	Reference	TD/BU (LES)	AR (AIDS)	TD/BU* (AIDS)
National		31,09	-1,95	2,23	-4,96
Household Head Education Level	0	53,52	-0,5	0,77	-3,4
	1	48,88	-1,85	2,15	-4,36
	2	39,24	-1,51	2,66	-4,75
	3	33,95	-3,35	1,98	-5,52
	4	21,43	-2,69	2,56	-6,87
	5	12,09	-2,63	2,78	-7,98
	6	2,72	-2,84	0	-3,78

Results: Inequality variation(S-Gini)

	Code	Reference	TD/BU (LES)	AR (AIDS)	TD/BU* (AIDS)
National		0,52	0,12	0,16	-1,68
Gini Décomposition par niveau d'éducation					
Inter-Groupes		0,45	0,12	0,21	-1,68
Intra-Groupe		0,06	0,08	-0,14	-1,69
Household Head Education Level	**0**	0,4	0,17	0	-3,24
	1	0,41	0,1	0	-3,13
	2	0,41	0,03	0	-2,59
	3	0,42	0,09	0	-2,3
	4	0,41	0,14	0	-1,63
	5	0,46	0,02	0	-1,1
	6	0,49	0,22	0	-0,55

Concluding remarks

- An Almost Ideal Demand System can be used in the TD/BU microsimulation approach.
- Found that that AIDS does not aggregate well as oppose to what Deaton and Muelbaeur (1981) state
- More complex than anticipated
- AIDS modifies results vs LES.
- Much stronger distributional changes versus LES (and C-D).
- Our application does not fully exploit the AIDS as sub-groups parameters could be used
- This should amplify our conclusions