Agricultural trade liberalization in a world of uncertainty: discussion of the results of a world CGE model

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Agricultural trade liberalization in a world of uncertainty: a CGE model

by

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CGE and agricultural trade liberalization

- CGE good to take care of sectoral interactions
- Easy to make use of (thanks to GAMS/GTAP!)

- Yet dangerous !

- be careful not to confuse model and reality!

- Such confusions occurred when evaluating benefits from agricultural trade liberalisation

The problem of agricultural trade liberalization

- Agriculture disconnected from market since Roosevelt
  - Concern with food security issues
  - Ezekiel analysis of price instability
- Reinserted into WTO negotiations in Marrakech
  - "Farm problem" (Olson, Gardner) issues
  - Overproduction problems in developed countries
  - Large efficiency gains expected from comparative advantages
- CGE models played a role in evaluating change
  - Gains significant, but less than expected
  - Stability issues neglected

Why is stability important in agriculture ?

- **Large efficiency gains may be expected from stabilized prices**
  - **Farmers (and bankers) are risk averse**
  - **Risk premium are inefficient**
- **Neglecting instability may underestimate benefits from liberalisation**
  - **Mutualising losses may have an insurance effect, and decrease climate induced price fluctuations (Bale and Lutz)**
- **Neglecting instability may overestimate benefits from liberalisation**
  - **If genuine market instability always keeps prices away of equilibrium**

Now, CGE's ignore instability !

- They fail to take account of the facts at the origin of price intervention in agriculture, and thus, of the very problem they are addressing
- They thus may under- or over-estimate benefits from liberalisation, and misguide political bodies

But how can we introduce risk and instability into a CGE model ?

Three key points in modelling risk and instability in CGE's

- First order conditions in presence of risk
- The possible local instability of market equilibriums
- How is capital allocated to sectors ?

First order conditions in presence of risk :

- **Neglecting risk leads to the standard first order condition:**

$$\hat{p}_j \frac{\partial q_j}{\partial x_i} = p_i$$

q_j : quantity of output j ;
p_i : equilibrium price of input i;
$\hat{p}_j$: expected price of output j
x_i : quantity of input i

- **Introducing risk gives:**

$$\tilde{p}_j \frac{\partial q_j}{\partial x_i} = p_i$$

$\tilde{p}_j$: Certainty equivalent of expected price $\hat{p}_j$

Under standard Markowitz utility function,

$$\tilde{p}_j = \hat{p}_j - A\hat{\sigma}_j^2 q_j$$

- **This is easy to put in a CGE model !**

Modelling instability

- Sources of instability
- Exogenous: No problems…
- Endogenous:
  - Lags in delivery

    [while standard CGE's assume consumption and production are simultaneous]
  - Imperfect expectations

    [while standard CGE's assume expectations are not only *rational* but also *perfect*]
  - Poorly elastic demand

    [how are demand elasticities in most models ?]
- The road to explosive cobwebs

  [but risk as a return string]

How is capital allocated to sectors ?

- **The third component: Non shiftable capital**
  - **If capital is sector specific, savings must be allocated between sectors**
  - **Then, a classical Markowitz model makes the trick: In a separate module, households choose z to maximize:**

with:

$$U = \sum_k \hat{\pi}_k z_k - A \hat{\sigma}_k^2 z_k^2$$

$\hat{\pi}_k$: Expected profitability of capital in sector k
$\hat{\sigma}_k$: Expected variance of profitability in k
z_k : share of savings invested in sector k
A : risk aversion coefficient of household

- **Clearly, risk matters again**

These ideas have been implemented in a large model in progress

- A GTAP model
- Two versions : Standard CGE
  Incertitude
- World aggregations :3regions /10 sectors
  12 regions/10 sectors
- 6 sectors related to agriculture

Model presentation

➔main characteristics shared by the 2 versions :

-economy wide model, world coverage

-recursive dynamic

- production function : CES of CI(aggregate intermediate consumption) and VA (aggregated added value)

- consumption : linear expenditure system

- international trade : armington, bilateral flow

- GTAP parameters, parametric difference between regions

- Endogenous volume and prices for goods and factors

- closure : Investment=Savings, endogenous trade balance

The 10 Sectors

- 1. **Paddy**
- 2. **Grains :** Wheat,others cereal grains
- 3. **Autres cultures :** Vegetables-fruits-nuts, oil seeds, sugar cane-sugar beet, plant-based fibers, others crops
- 4. **Productions animales :** Bovine cattle-sheep-goats-horses, other animal products, raw milk, wool, silk worm cocoons, fishing
- 5. **Sylviculture**: Forestry
- 6. **Industries agro-alimentaires** (9 secteurs GTAP)
- 7. **Industries du bois**
- 8. **Manufactures** (15 secteurs GTAP)
- 9. **Energie et ressources naturelles** (7 secteurs GTAP)
- 10. **Services** (4 secteurs GTAP)

Other features

five production factors :

- Land : used only by agricultural sectors, perfect mobility, flexible prices
- Natural resources : used only by forestry and energy-resources sectors, perfect mobility, flexible prices
- Highly qualified workers : mobility inside aggregated sectors, rigid wages
- Low qualified workers : mobility inside aggregated sectors, flexible wages
- Capital : sector specific, flexible prices

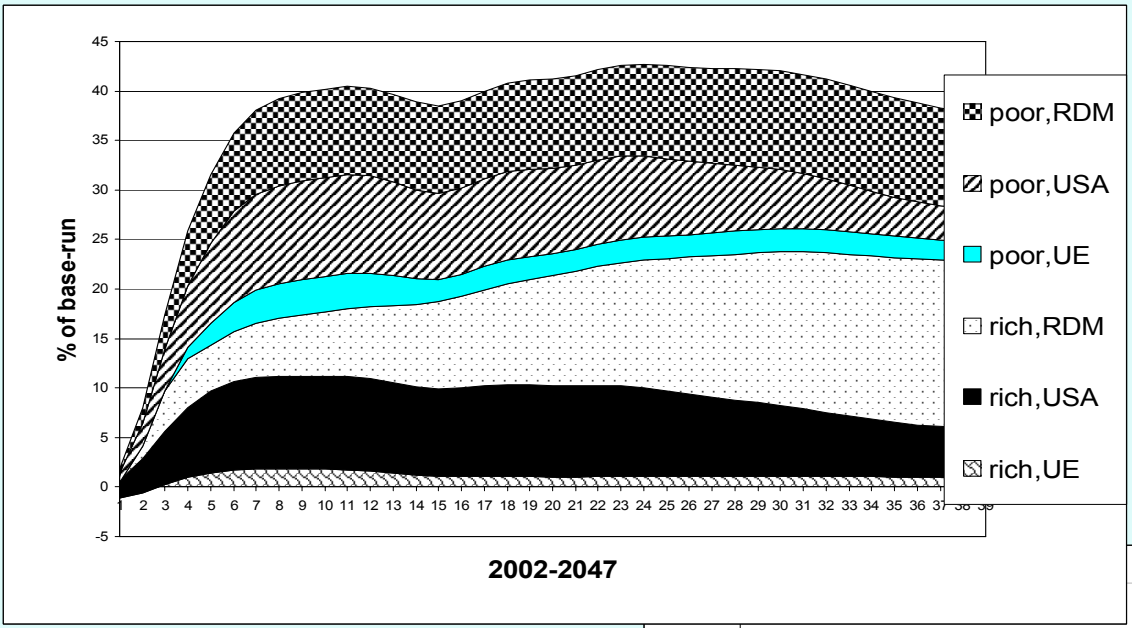
2 types of households : Middle-Rich / Middle-Poor

2 modules :

Real : physical flows of products
consumption and production decision

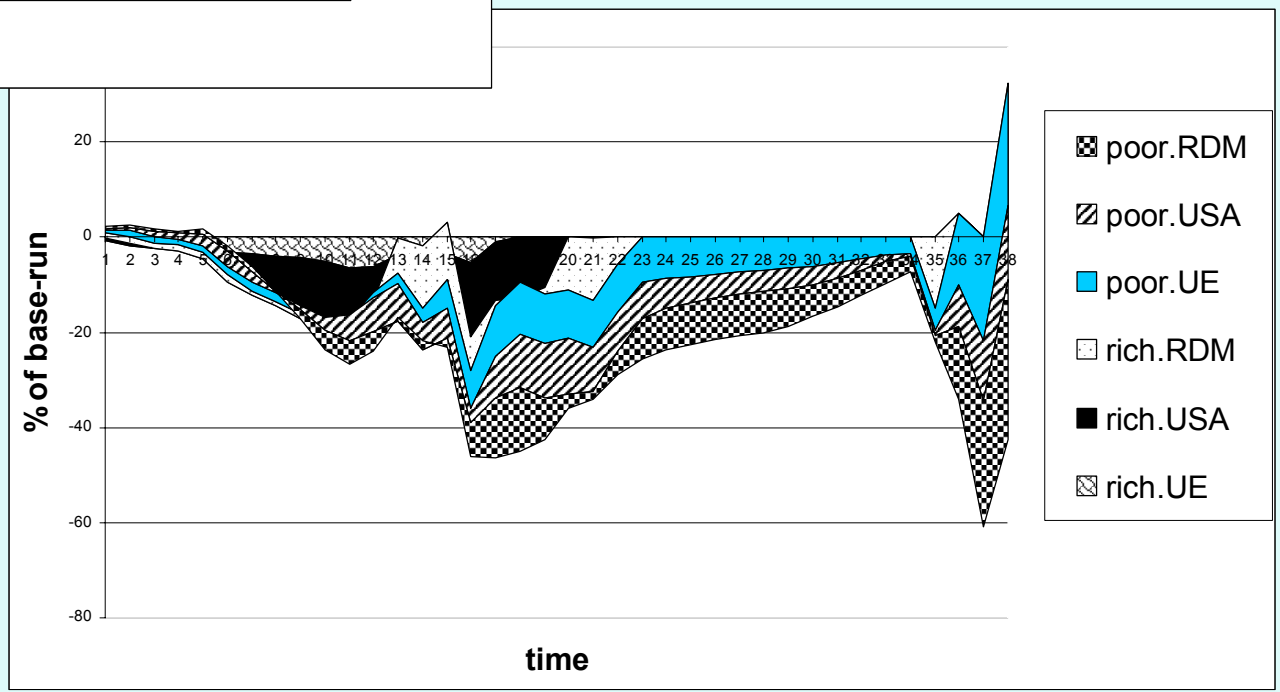
Financial :investment decision

Preliminary results



Gains associated with trade liberalization in the standard version

Losses associated with trade liberalization in the version considering risk and uncertainty



Research agenda and conclusion

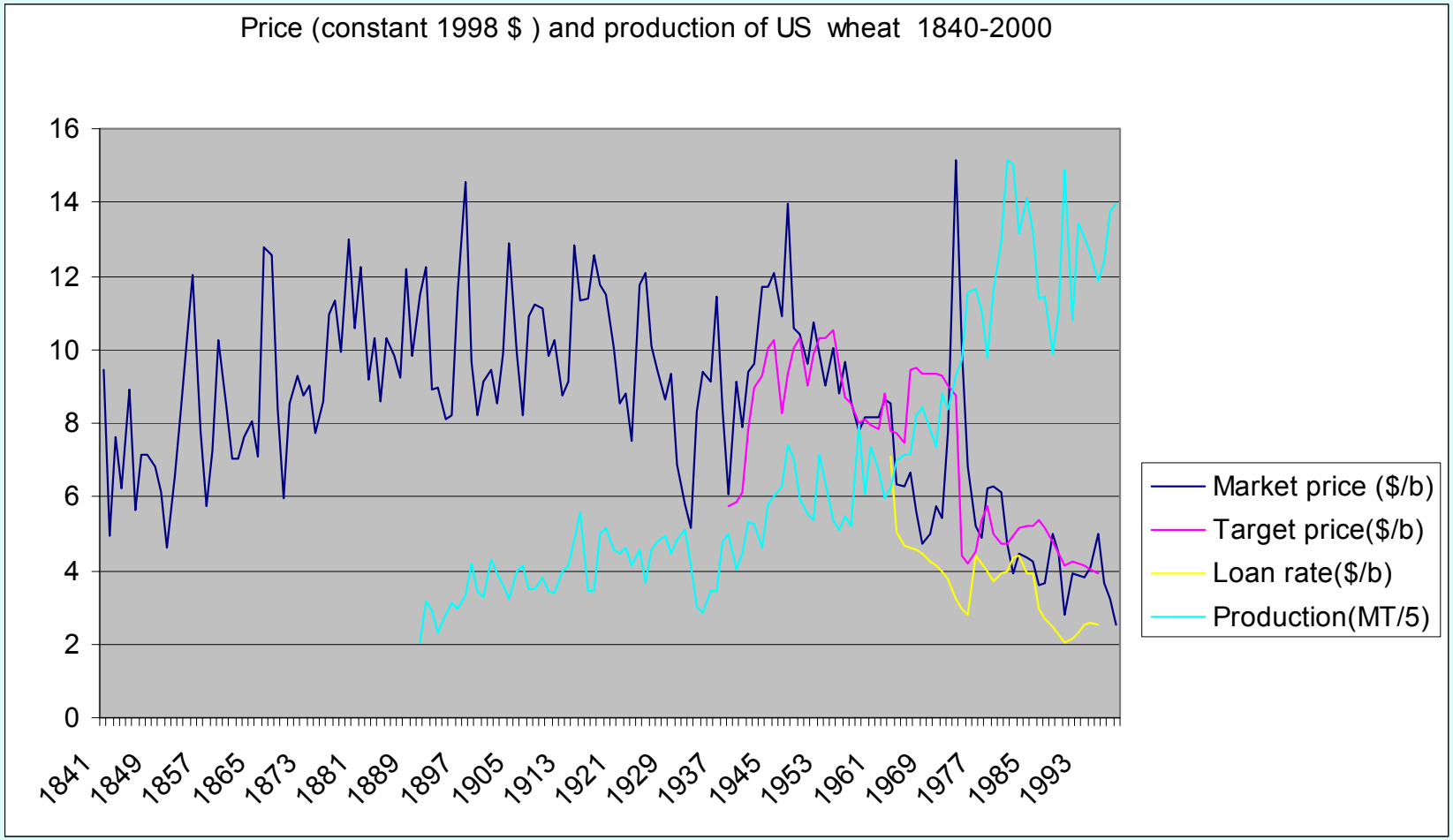
➔**In progress:**
Calibrating, performing sensitivity analysis and validating on real data the reference scenario….

Improving capital module : endogenous exchange and interest rates

➔ **But we can be sure of :**

- Liberalization gains may be considerably reduced by uncertainty
- Necessity to define market friendly intervention, which may prevent crisis

An example :


Price (constant 1998 $) and production of US wheat 1840-2000
16
14
12
10
8
6
4
2
0
1841
1849
1857
1865
1873
1881
1889
1897
1905
1913
1921
1929
1937
1945
1953
1961
1969
1977
1985
1993
Market price ($/b)
Target price($/b)
Loan rate($/b)
Production(MT/5)

The agricultural exception