Boundedly Rational Exuberance on Financialized Commodity Markets

The case of agricultural commodities

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Why this research?

- **Both farmers and traders all around the world at pain to understanding volatility, as well as food crises**

  ⇒ Think Tank Momagri (international perspective)

  ⇒ First report February 2006: Flabbegasted !

- **CGE Models: neither risk, nor innovation, nor environment…!**

  + Plea of R. E. Just (A Jl A Econ, 2001)

  ⇒ Momagri Model, to begin with volatility…

Contents of the Talk

I. **Specifics of 'financialized' markets ?**

II. **The model: Market participants' behaviors**

III. **General equilibrium: volatility**

IV. **And now?**

I. Financialized Markets?

I. Specifics of 'financialized' markets ?

II. The model: Market participants' behaviors

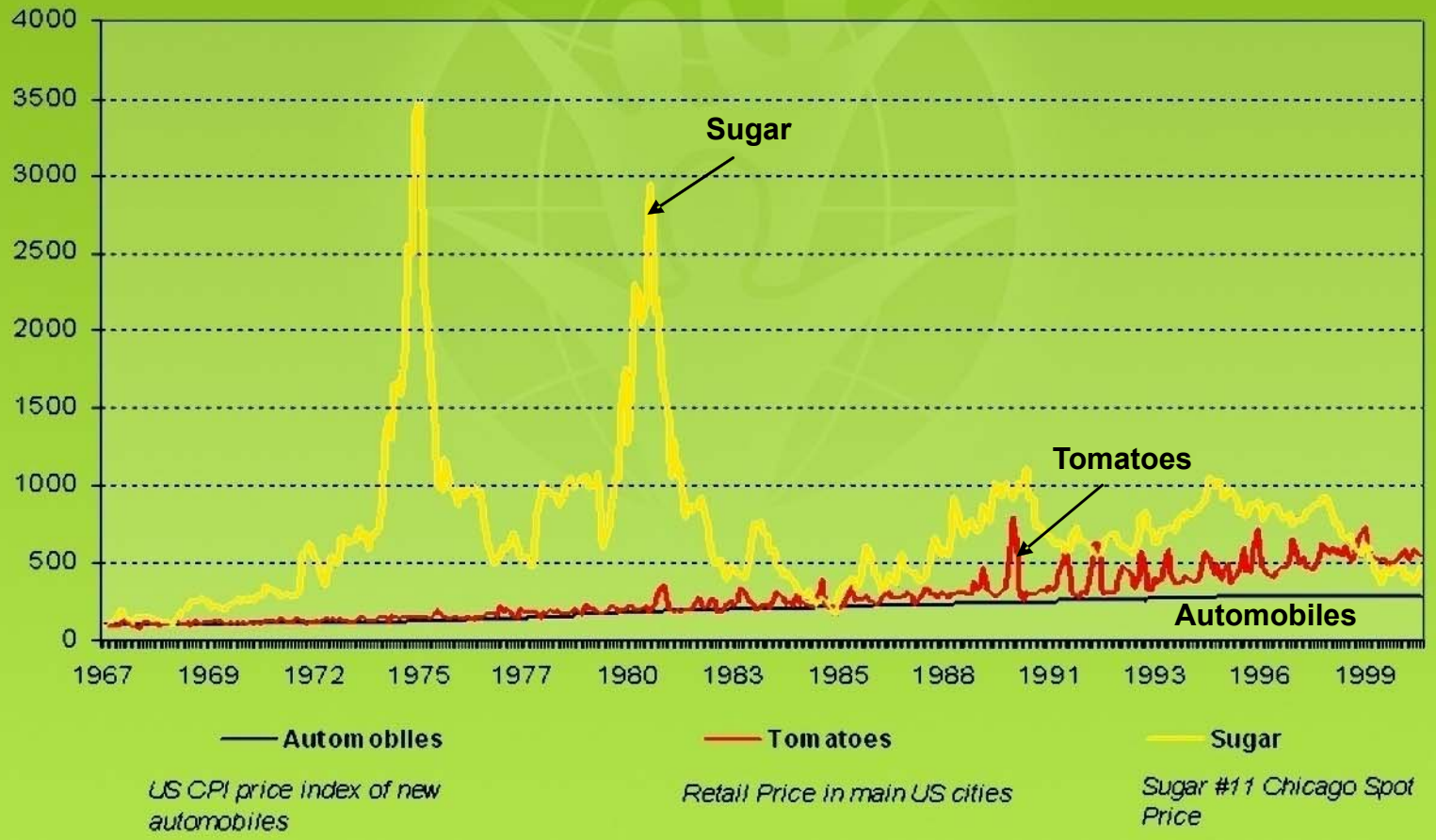
III. General equilibrium: volatility

IV. And now?

You said « financialized »?

- **We call furtherdown here « financialized » those markets, the physical output of which is being also used as underlying for financial transactions.**
- **Such transactions bear on risk exchange: they can be tools to cover for some risks, but also tools to make money through short term investments (speculation in most cases)**
- **Whether financialized (sugar) or not, agricultural markets are specific ones…**

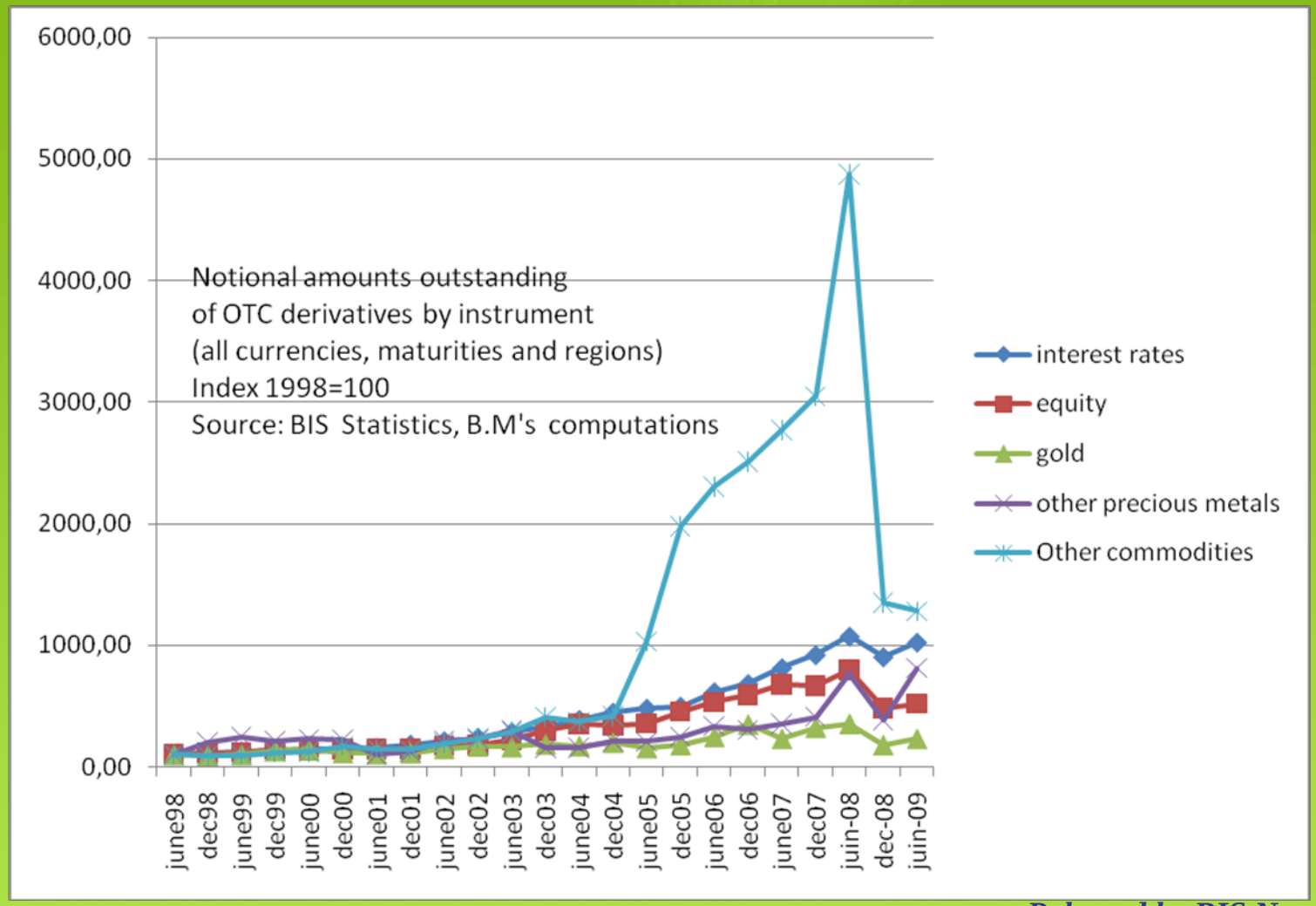
Markets: Fluctuations in Tomatoes, Sugar and Automobiles prices 1967 - 2002



Source : economagic

Financialization: Recent evolution

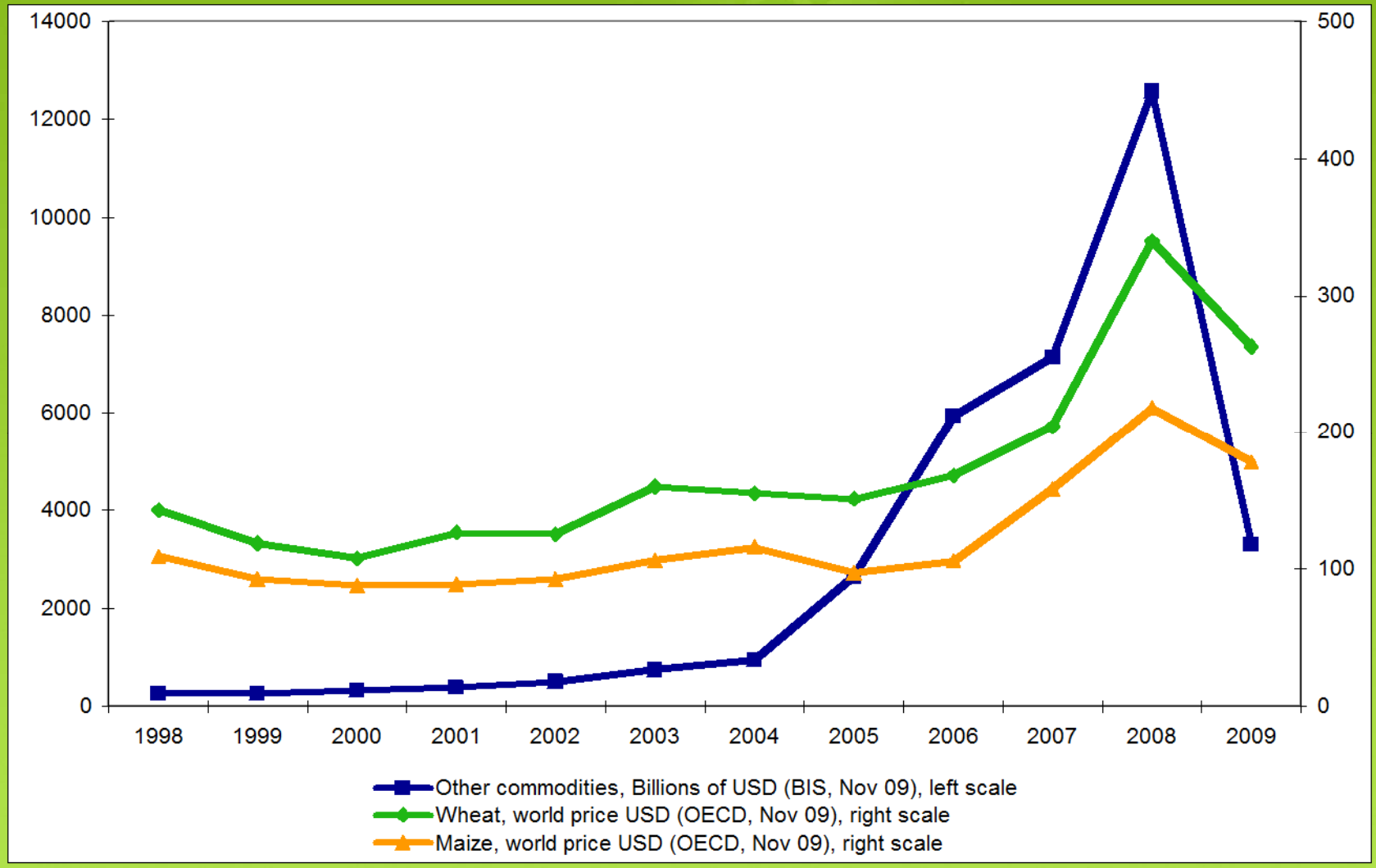
Amounts in Bns $



Released by BIS Nov. 12, 2009

N.B.: Speculation hasn't been always profitable: it recently receded!

Sensitivity of commodities prices to OTC's investors entry and exit



II. Modeling participants behavior

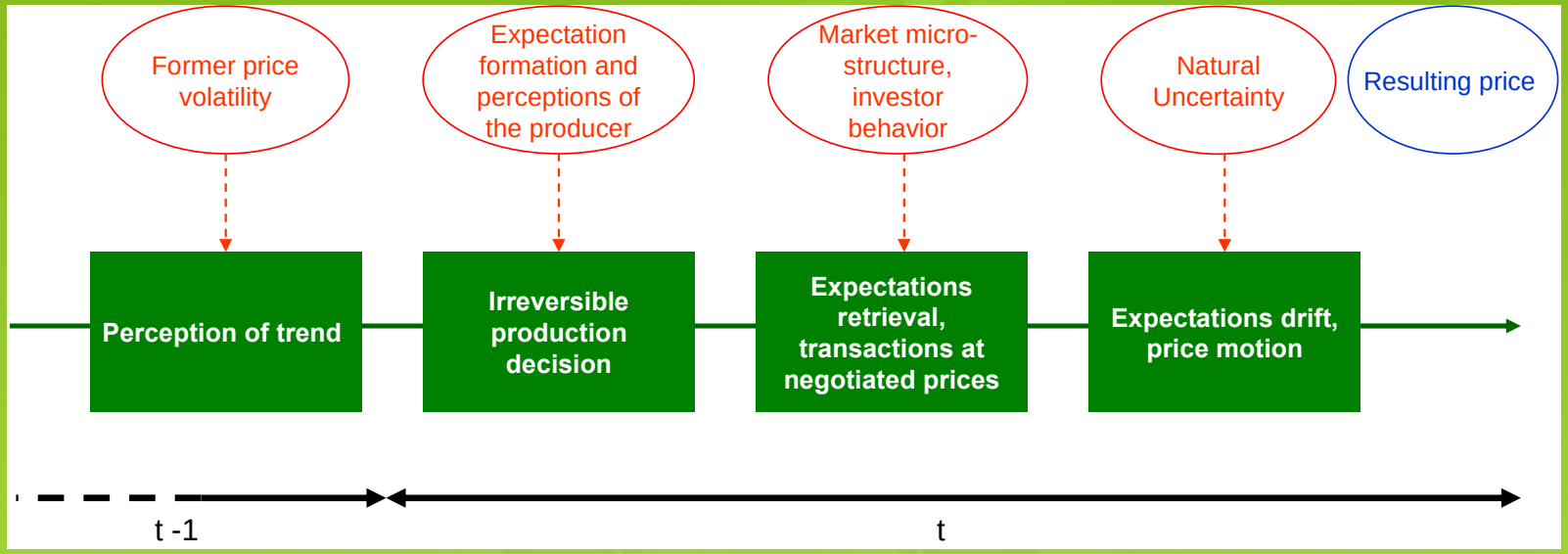
I. Specifics of 'financialized' markets ?

II. The model: Market participants' behaviors

III. General equilibrium: volatility

IV. And now?

Agricultural market specific macrostructure



- **Producers: Irreversible decisions**
- **Producer's information « revealed » to other actors**
- **Short term investors: different preferences, better informed (the 'experts' of Einhorn and Hogarth, 1985)**

⇒ Under ambiguity, 'attraction of' (impact on) spot prices

Specific microstructure of commodity markets

- **Market's microstructure: economists do not consider that there is only *one* way of organizing markets (≠ 'Commissaire priseur')**
- **No call markets (of the Walrasian type), but rather OTC negotiation markets**
- **Imperfect information**
- **Informational externalities (Stein, 1987)**
- **Relative inefficiency (Moulet and Kirman, 2008)**

Non tâtonnement and prices

- **Non-unicity of prices on *negotiation markets* (OTC's short term investors). And an average ≠ 'unique price'!**

- **Impact of forward transactions: Quantities → impact on daily forward (& spot) quotations**

- **But also: New traders ⇒ 'informational externality' on spot transactions negotiated meanwhile**

⇒ Even if these additional short term investors re-sell later, the *informational externality* impact will have been exerted on *both* forward *and* spot prices

(Stein, 1987, Kocagil, 1997, etc.)

Producers expectations

$$R_{m,t} = \frac{R_{t-3}}{6} + \frac{R_{t-2}}{3} + \frac{R_{t-1}}{2}$$

$$R_{a,t} = CE(\tilde{R}_{m,t})$$

$$P_{a,t} = \mu . \frac{R_{a,t}}{R_{t-1}} . P_{r,t-1} + (1-\mu).PN]$$

- **Exponentially decreasing rate of forgetfulness**
- **Uniform distribution**
- **Anticipating price based on past revenues**
- **Anticipating as a compromise between observation and *idea* of « essentials »** (notional)
- **Standard certainty-equivalent to be adjusted**

Risk attitude of farmers-producers

- ***Probabilist vision*: the past is one drawing of observations. We don't trust it 100% and this entails a « probability transformation »**
- ***Adjustment of the idea* here : pessimism (optimism) corresponds to a 'discouraging' ('encouraging') memorized *context* and:**

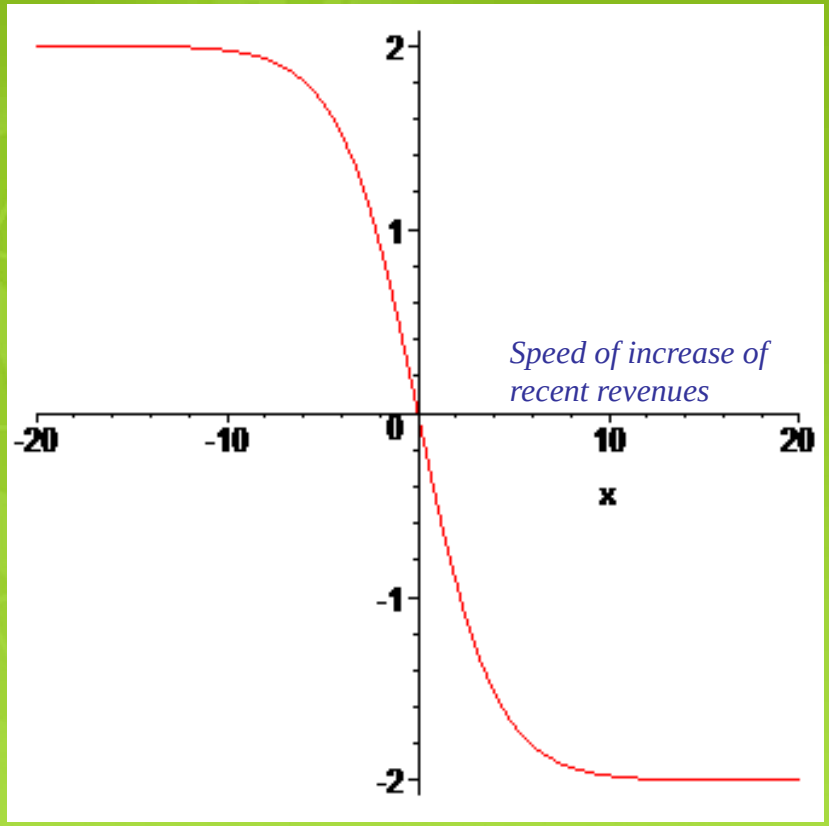
$$p_h^* = \varphi[\sum_{i=h}^{i=n} p_i] - \varphi[\sum_{i=h+1}^{i=n} p_i]$$

- **With $\varphi(.)$ convex on 'ranked' probabilities and:**

$$\theta(0) = 0, \theta(1) = 1, \forall p,\ \varphi'(p) > 0$$

The Theta function

- **Links probability transformation to context and impacts on the riskpremium on Revenues:**



$$R_{a,t} = E(\tilde{R}_{m,t}) - \theta(R_{t-3}, R_{t-2}, R_{t-1}).\gamma.\sigma^2(\tilde{R}_{m,t}) / 2E(\tilde{R}_{m,t})$$

Where γ stands for the RRA Arrow-Pratt coeffic.

Supply, demand, natural risk, Notional equilibrium

$$y_{a,t} = \frac{1}{d} . P_{a,t}$$

$$y_t = y_{a,t} . \eta$$

$$x_t = \frac{a - P_{r,t}}{b}$$

$$PN \cong \frac{ad}{b+d}$$

- **Cst. returns to scale, adjt. to prod funct in CM**
- **η is $\mathcal{N}(1,\sigma)$. Parameters a, b, d>0 determined from Central Module, with linear demand schedule $\Rightarrow$ PN as above is approximate and, above all, only an ideal reference:**
- ***"The equilibrium state of production is like the equilibrium state of exchange, an ideal state, not a real one. It never materializes […]."*** **(L. Walras**, *our translation*)

Short term investors expectations

- **Investors use two alternative types of anticipation**
- **The ‘naïve’ ones… and the ‘conservative’ or ‘fundamentalist’ones** (Kirman 1991, Anderson, de Palma and Thisse, 1992, Brock and Hommes, 1997, Westerhoff, 2003,etc.)
- **The proportion of investors using the naïve rule decreases with the gap between prevailing expectations by farmers and the preceding price:**

$$w_t = \frac{1}{1+|g|^2}$$

Investors net impact

$g_t = P_{a,t} - P_{r,t-1}$

$$\phi(\Delta Inv_{t-1}, x_{t-1}) = 1 + \Delta Inv_{t-1} / x_{t-1}$$

$$\frac{m.g_t[k^N / \varphi(Inv_{t-1}, x_{t-1})] - k^C \left|g_t\right|^j)}{i_t(1+\left|g_t\right|^j)})$$

***m, k^N, k^C >0* exogeneous**

i_t: monetary interest rate

- **The last relation represents the net attraction upward on spot prices** (or net demand added)
- ***Ex post*, it will translate into price changes, without having to be reflected into inventories.**

  (Δ inventory $\Rightarrow$ Δ price more than the reverse)

A Resulting Price Equation

- **Finally, one gets the equation of the price movements w.r.t. the previous price as the sum of two factors:**

Farmers **Investors**

$$P_{r,t} - P_{r,t-1} = -\frac{b}{d}(P_{a,t} * \eta_t - P_{r,t-1}) + b.\frac{m.g_t[k^N / \phi(Inv_{t-1}, x_{t-1}) - k^C |g_t|^2]}{i_t(1+|g_t|^2)}$$

This a non-linear difference equation, which results in alternating movements and can, Under some specific initial states and parameters specification, result in chaotic behavior

Financialized markets are complex sytems!

III. General equilibrium: Volatility

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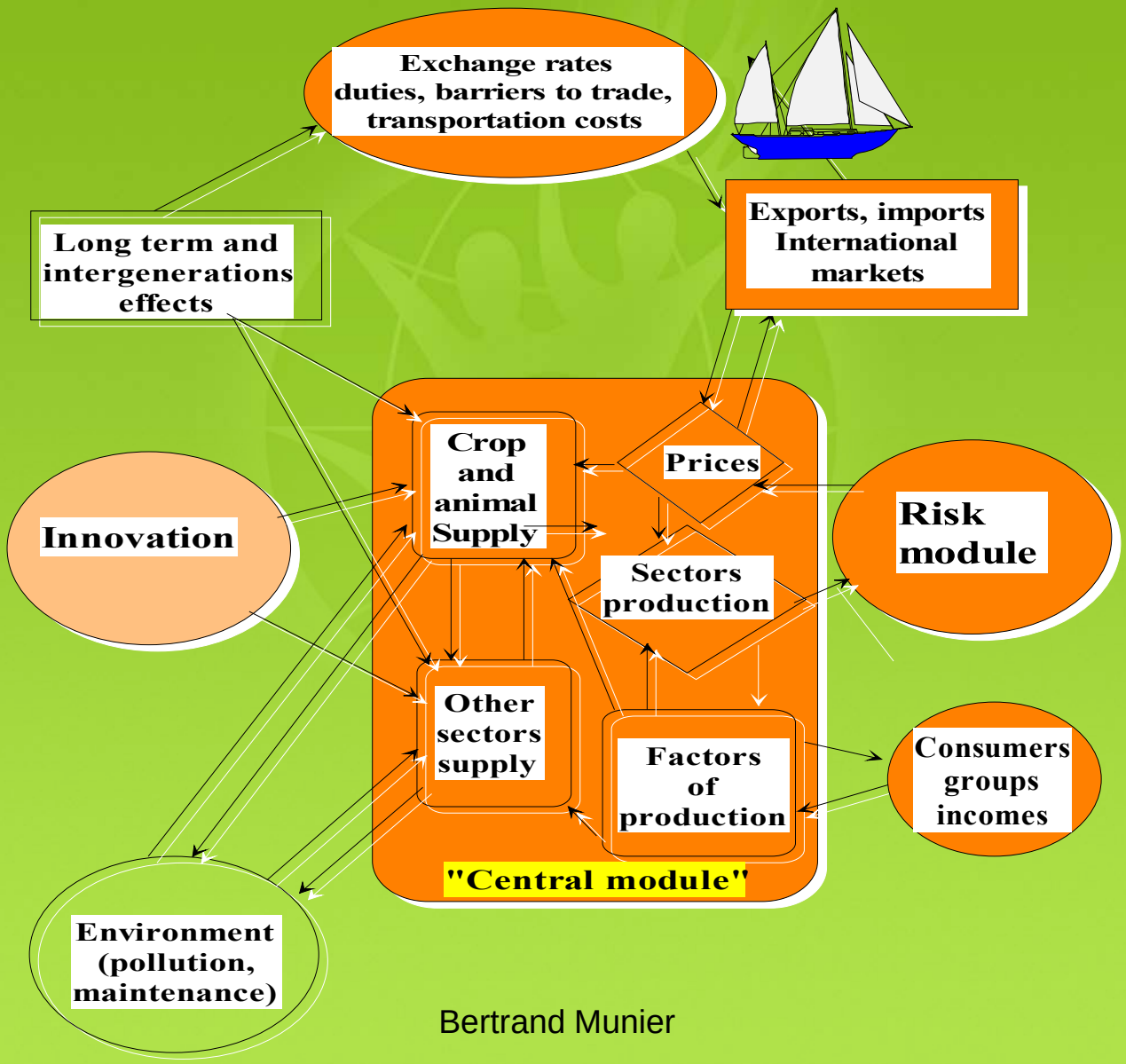
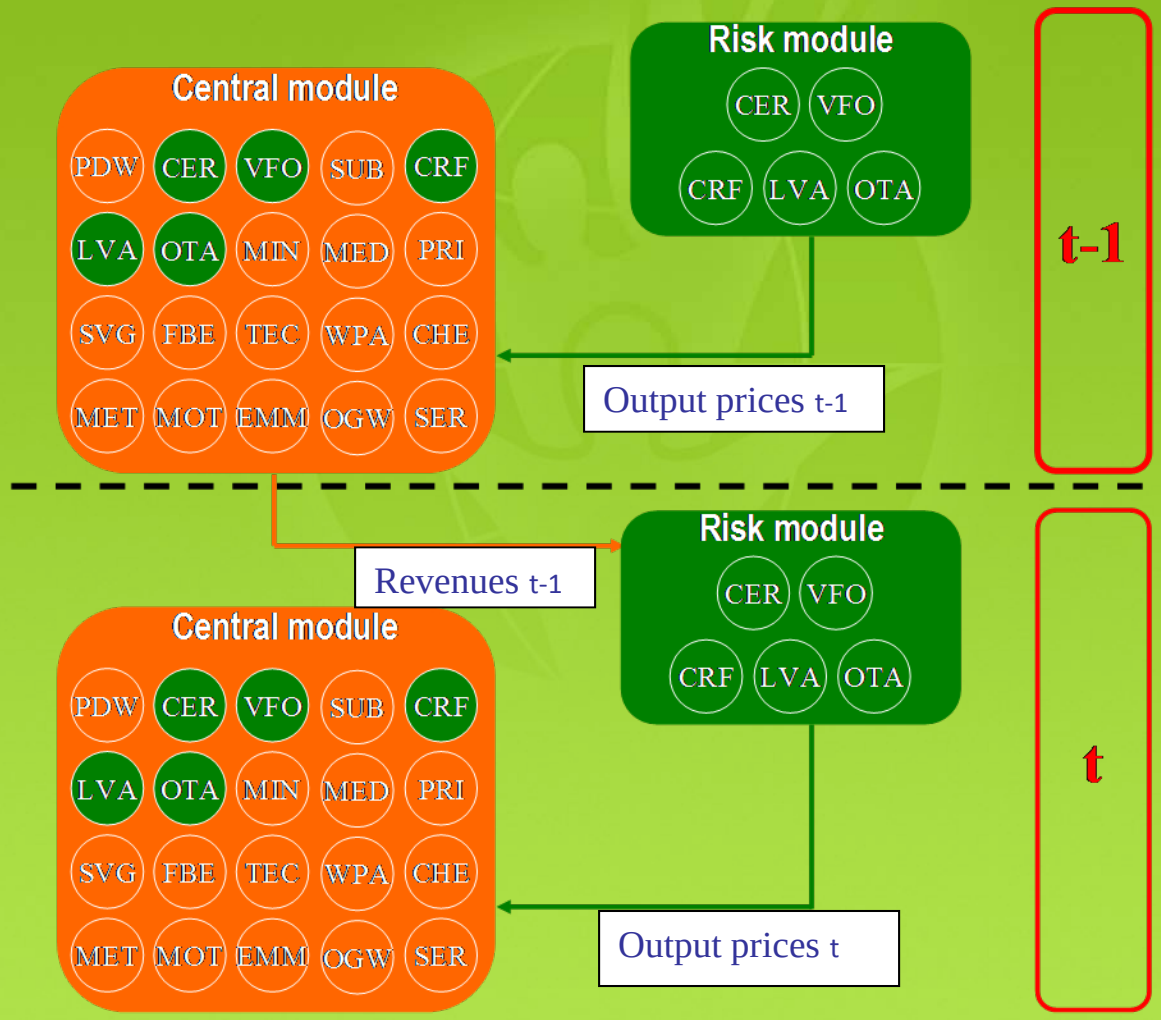
IV. And now?

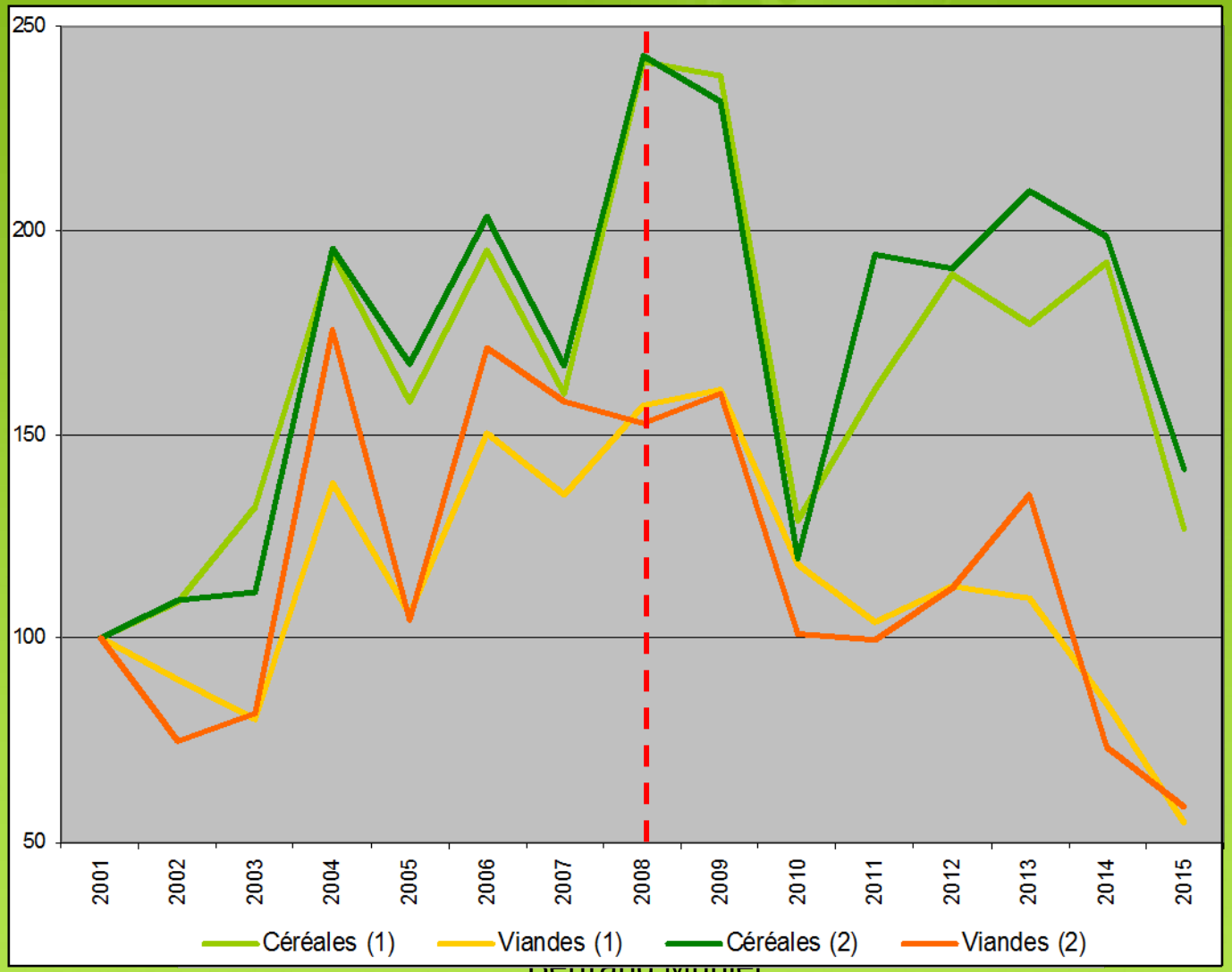
Momagri's *modular* structure



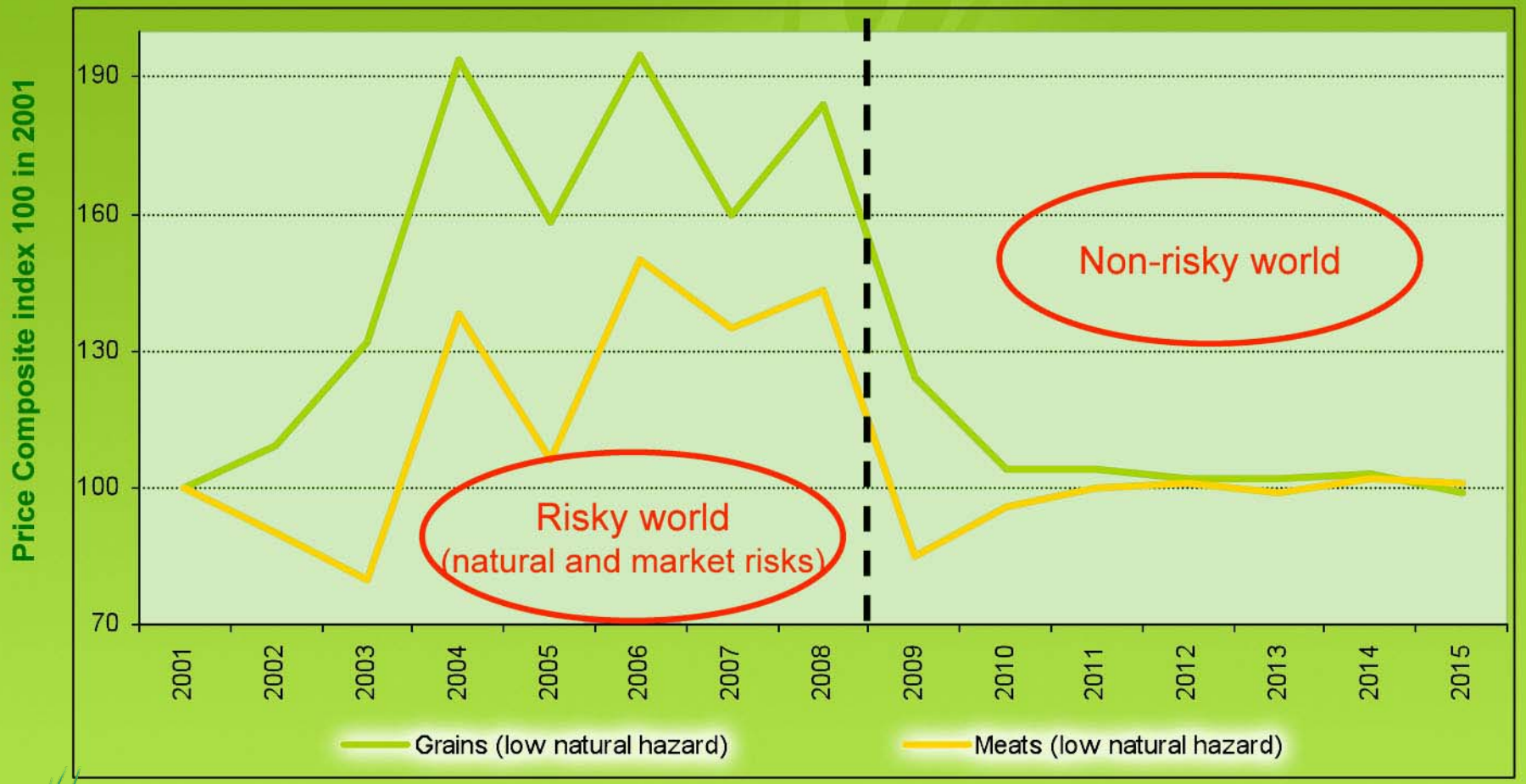
Recursive data exchange between modules



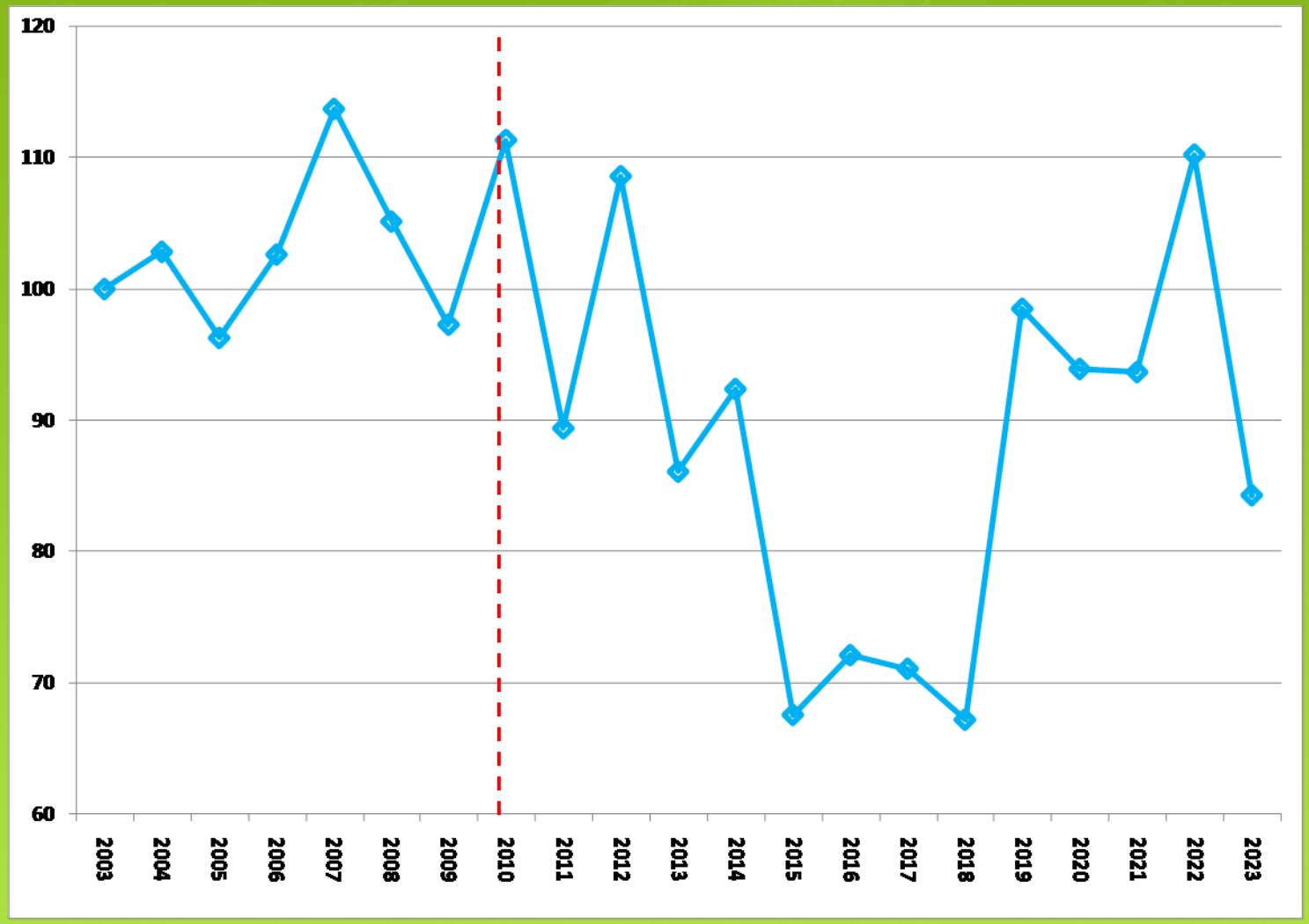
Simulation : 70% liberalization (all sectors) starting in 2008 (momagri model prototype)



A simulation where risks would be eliminated today (momagri model prototype, March 08)



Cereals world prices /15 years (momagri model)



Extreme liberalization in 2010: If anything, volatility increases

IV. And now?

1. **Question of studying volatility without the (implicit) hypothesis of separability investors / other actors**

2. **Multiple policy implications: Foster growth or stabilization (Are Lucas' arguments still valid?) Price limits?, OTCs? Inventories?)**

3. **The 'Dahlem issue'…: How we should (and should not) model financialized markets if we want to learn bette than we have done.**