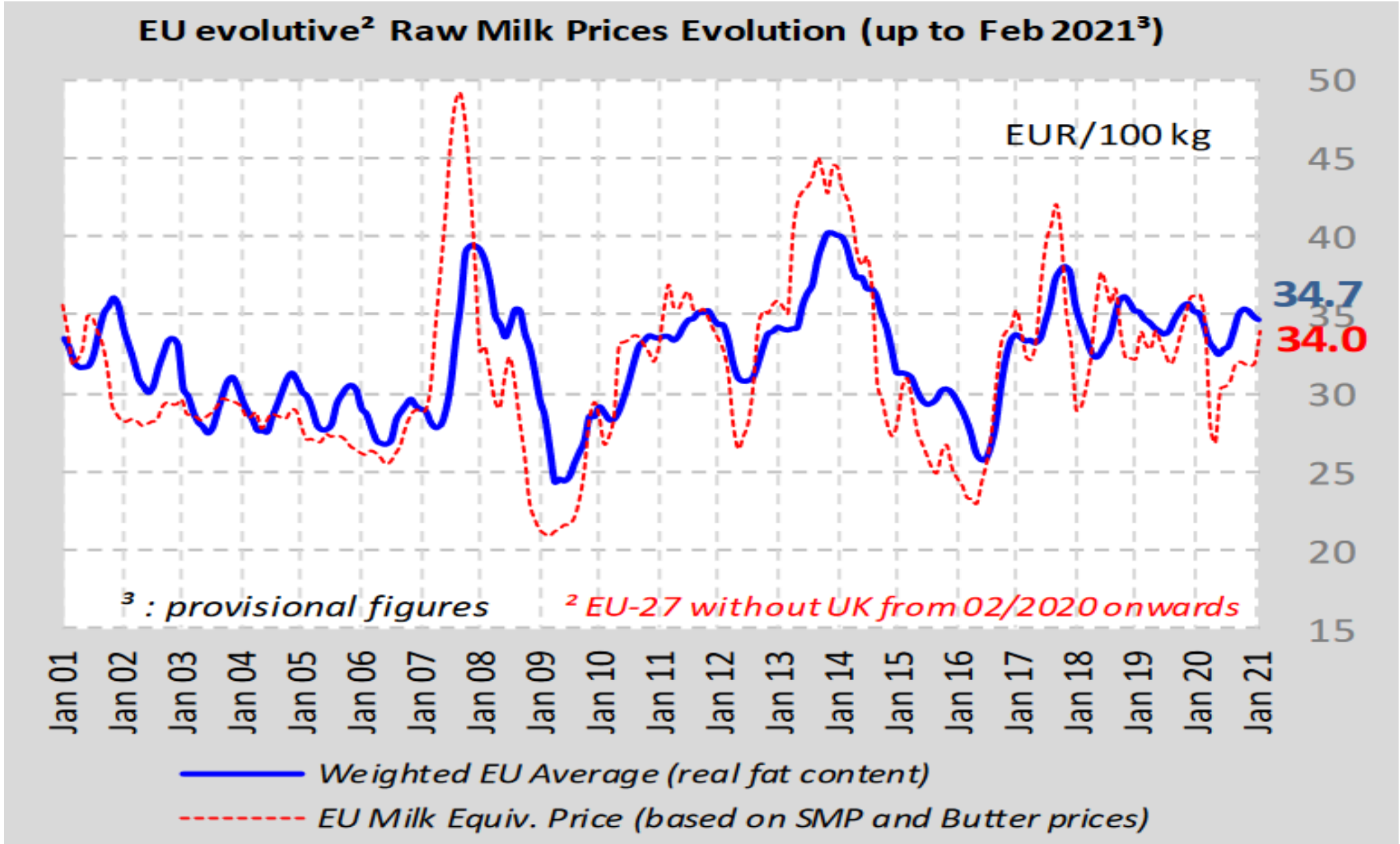
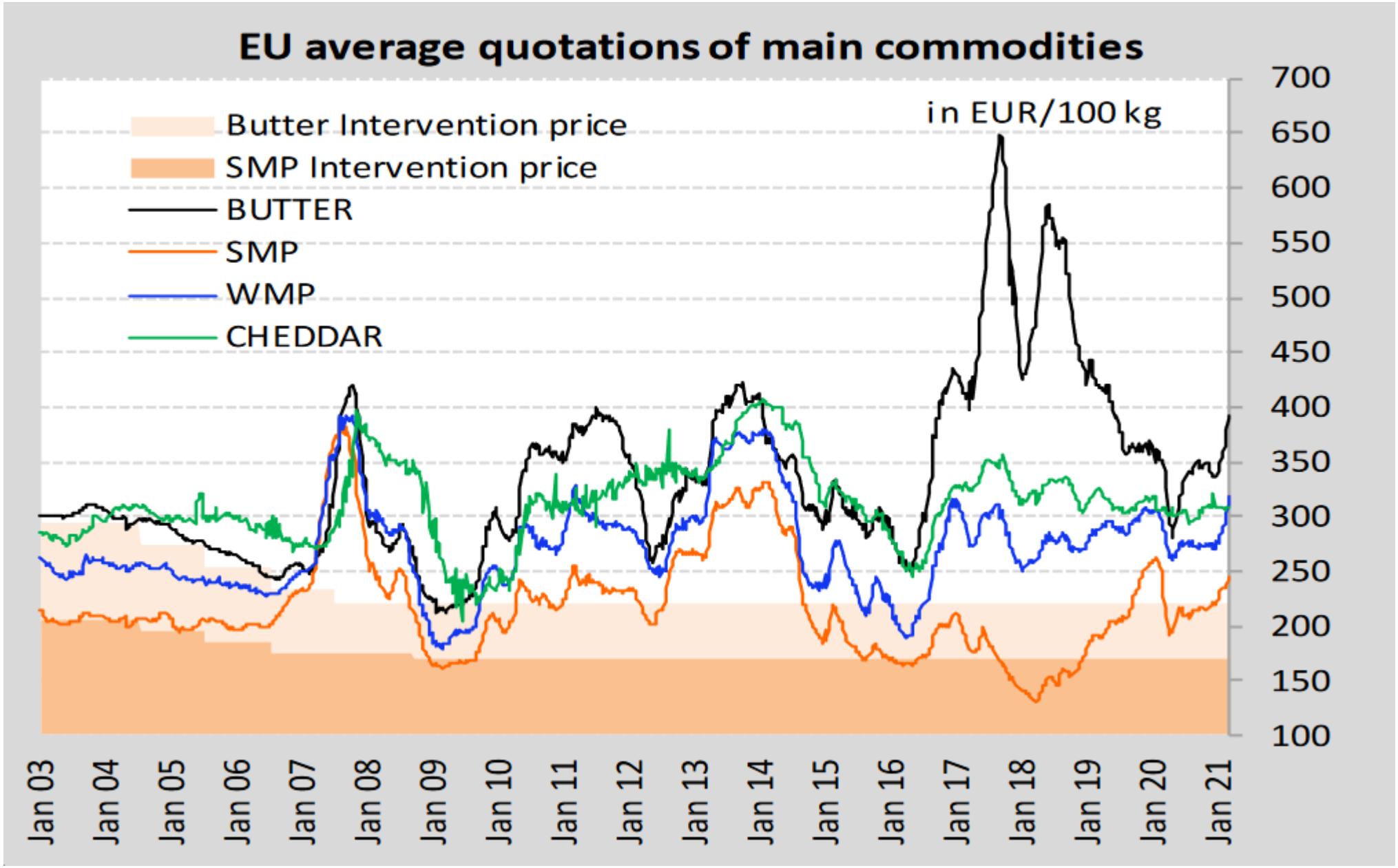
Understanding the European Futures Markets on Dairy Products: a Multi-Product Perspective

Guillaume Bagnarosa RSB, Jean Cordier AO et Alexandre Gohin INRAE

Journées SFER Avril 2021


EU evolutive² Raw Milk Prices Evolution (up to Feb 2021³)
EUR/100 kg
50
45
40
35
30
25
20
15
34.7
34.0
³ : provisional figures
² EU-27 without UK from 02/2020 onwards
Jan 01
Jan 02
Jan 03
Jan 04
Jan 05
Jan 06
Jan 07
Jan 08
Jan 09
Jan 10
Jan 11
Jan 12
Jan 13
Jan 14
Jan 15
Jan 16
Jan 17
Jan 18
Jan 19
Jan 20
Jan 21
Weighted EU Average (real fat content)
EU Milk Equiv. Price (based on SMP and Butter prices)


EU average quotations of main commodities
in EUR/100 kg
Butter Intervention price
SMP Intervention price
BUTTER
SMP
WMP
CHEDDAR
700
650
600
550
500
450
400
350
300
250
200
150
100
Jan 03
Jan 04
Jan 05
Jan 06
Jan 07
Jan 08
Jan 09
Jan 10
Jan 11
Jan 12
Jan 13
Jan 14
Jan 15
Jan 16
Jan 17
Jan 18
Jan 19
Jan 20
Jan 21

European Commission

EU Agricultural Markets *Briefs* | No 11 | March 2017

Managing risk in the dairy sector: how futures markets could help

Table 1: Dairy futures worldwide

Info displayed: contract size, maturities available, creation of the contract in the current form.

Colour code: orange means physical delivery, light-blue is cash-settled and dark-blue is cash settled with options available.

	New Zealand (USD)	US (USD)	EU EEX (EUR)	EU Euronext (EUR)
Milk Class III[12]		90 t 24 months 2000		
Milk Class IV[13]		90 t 24 months 2000		
Milk MKP[14]	6 000 kg milk solid, yearly (5y) 2016			
Butter	1 t 18 months 2014	9 t 24 months 2005	5 t 18 months 2015	6 t 18 months 2015
Butter oil, AMF (Anhydrous Milk Fat)	1 t 18 months 2011			
SMP	1 t 18 months 2011	20 t 24 months 1993	5 t 18 months 2015	6 t 18 months 2015
WMP	1 t 18 months 2010			
Standard whey powder		20 t 24 months 2007	5 t 18 months 2015	6 t 24 months 2015
Cheddar Cheese		9 t 24 months 2010		

Source: Euronext, EEX, CME, NZX; more details on contract specifications by following the links.

Table 2: Share of dairy production traded on futures market (open interest/production)[15]

	2012	2013	2014	2015	2016
EU SMP				0.2%	0.9%
US SMP	3.0%	3.8%	8.0%	11.6%	12.1%
NZ SMP	0.1%	0.7%	0.2%	0.7%	1.1%
NZ WMP	0.3%	0.3%	0.5%	1.1%	1.5%
EU butter				0.1%	0.2%
US butter	4.6%	5.1%	6.3%	6.6%	6.4%
NZ butter	1.7%	0.7%	0.3%	0.7%	0.7%
US whey	n.a.	n.a	n.a	n.a	n.a
EU whey				0.0%	0.0%
US milk	2.8%	2.6%	3.8%	3.5%	3.4%
US cheese	1.3%	1.2%	2.8%	4.9%	4.6%

Research question :

Why are futures markets on European dairy products illiquid?

While crop futures markets quickly expand after CAP reforms.

Is it too early for dairy products?

Or some specificities of the milk sector?

Literature review on existence of futures markets

- First insights of Black (1986) and Gray (1978) remain valid. These factors include:
- On the physical markets:
  - Must be sufficiently volatile
  - Agents risk averse
  - Other solutions to manage the consequences of risks are not “ideal”
- On the futures markets :
  - Low “transaction” costs : delivery/cash settlement, homogenous good or grading system, electronic trading
  - Price convergence at settlement
  - The presence of market makers/scalpers, at least in the initial phase
- More generally :
  - No market price manipulation due to oligopsony/poly
  - Competition between futures markets or exchanges (incomplete vs missing contingent markets)
  - The public policy on both the physical and futures markets should be predictable.

Literature on dairy futures

- On the futures markets :
  - Basis risks: Bozic and Fortenberry (2012), O'Connor (2015), Weber (2017), Bialkowski et Koeman (2017)
- On the public policy:
  - Maynard et al. (2005), Newton et al. (2014) : role of US farm bills
  - Loughrey et al. (2018) stress the role of fiscal policy in Ireland

  - For the EU, what about the predictability of the EU crisis management? The case of 2016 and voluntary reduction of production.

Our approach : the demand of futures by dairy processors

- If no demand by these actors, the markets can not start.

- This potential demand depends:
  - on their expectations on the public policy. We assume that the Agenda 2000 CAP reform acting for reduced dairy prices is credible.
  - Depend on their production flexibility to depart from volatile markets. We statistically identify this from price and market data while the literature usually assumes full flexibility of dairy plants
  - Depend on the transmission to milk price. We will consider different milk price package

The economic program of dairy processors

Subject to $\quad max_{Y,X,H} EU(\pi_s) = \sum_s w_s U(\pi_s)$

Subject to $\quad \pi_s \leq PY_s.Y - PX_s.X + (F - tf - PY_s).H$

$$T(Y,X) = 0$$

The FOC:

$$\sum_s w_s.U_\pi(\pi_s).(PY_s - \lambda.T_Y(Y,X)) \leq 0 \quad (1)$$

$$\sum_s w_s.U_\pi(\pi_s).(PX_s - \lambda.T_X(Y,X)) \leq 0 \quad (2)$$

$$\sum_s w_s.U_\pi(\pi_s).(F - tf - PY_s) \leq 0 \quad (3)$$

The milk package : PXs = g(PYs)

Statistical estimation of the PPF on the 2001-2007 monthly data

- Quadratic multiproduct cost function:
  - $C_Y(w, Y, X) = w.(E + G.Y + H.X)$
- Private and public demands :
  - $D = F - BP + S$
- At the equilibrium:
  - $(I + G.B).P = E + G.F + G.S + H.X$
- Calibration of these parameters using Generalised Maximum Entropy, monthly data on stocks, prices and availability of milk components

Statistical estimation of the PPF on the 2001-2007 monthly data

Table 1. Econometric results of the price equilibrium conditions on 2001/2007

	Butter price	SMP price	Emmental price	Fat supply	Protein supply
Supply:					
Butter	3.32	-3.13	-1.37	1.20	-2.14
SMP	-3.13	7.95	-1.82	-2.85	3.46
Emmental	-1.37	-1.82	1.04	-0.22	-0.56
Demand:					
Butter	-0.72				
SMP		-0.60			
Emmental			-0.84		

Then price cointegration analysis under/without milk quotas

- Under the assumption of stable preference by consumers, this analysis reveal adaptation by processors

Table 2. Cointegration parameters between dairy and milk prices

	Butter	SMP	Milk
Period:			
2007/2015	1	1.47	-20.6
2015/2019	-	-	-
	Emmental	Whey	Milk
Period:			
2007/2015	1	3.06	-20.48
2015/2019	1	1.22	-16.04

- So the interim conclusion: dairy processors adapt their product mix to price signals. Now we examine how this translates into their demand of futures

Calibration of the economic program of dairy processors

- Initial situation : 2001, Average European dairy processors
- Technical coefficient: Bouamra Mechemache et al.
- PPF: Separability between inputs and outputs
  - CES(0.1) at the input side with three inputs : milk, variable inputs and capital. Cost shares from Agreste
  - CET(0.5) with five outputs from CAPRI
- Risk aversion : CRRA (2) => with 2% output price volatility, risk premium amounts to 1% of expected profits of dairy processors

Scenarios

- 1 « Price reduction » : we reduce intervention price of butter, SMP and equivalent WMP, Milk price as decided in the Agenda 2000
- 2 « Price volatility » : 1 + CV of butter, SMP and WMP increase to 15%
- 3 « futures markets »: 2 + transaction costs reduced to 10€/ton on futures
- 4 « futures markets without » : 3 + no production flexibility
- 5 « Milk package » : 25% transmission of butter/smp price volatility in milk price volatility

Simulation results

	Initial situation 2001	Price reduction	Price volatility	Futures markets	Futures markets without adaptation	Milk Package
Production (MT)						
Butter	1.8	-3.0	-4.2	-3.6	0	-2.0
SMP	1.2	-11.4	-14.0	-12.7	0	-8.6
WMP	1.0	-13.3	-14.5	-13.9	0	-12.2
Cheese	4.2	12.3	12.4	12.4	0	11.8
Oth dairy	Index	-1.4	-1.4	-1.4	0	-1.4
Milk demand (MT)	120	0.9	0.5	0.7	0	1.1
Hedging ratio (H/Y)						
Butter	0	0	0	63.3	74.7	0
SMP	0	0	0	22.0	63.0	0

Concluding comments

- European dairy futures are presently illiquid. Participation by dairy processors has so far been limited by:
  - Their production flexibility (that we estimate far from perfect)
  - Transmission to milk producers (through milk package)
- Many other reasons more difficult to assess:
  - Crisis policy of EU and Member States ?
  - Role of cooperatives ?
  - Current levels of milk prices ?
- No discussed at all in current CAP negotiations. Does it mean that the risk issue is « much ado about nothing » ? To be checked if milk prices decrease in next years.