Irrigation and risk management

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The role of irrigation in farmers' risk managament strategies: a French case study

The role of irrigation revisited

" Irrigation increases yields"

But:

• Irrigation comes at a cost.

• Higher gross margins for irrigators are also explained by generous irrigation premia granted by the Common Agricultural Policy.

| Maize production in 2000	Non irrigated	irrigated
yield (€/ha)	1010	1307
CAP compensation (FF/ha)	**300**	**448**
Gross charges (FF/ha)	556	858
Gross margin (FF/ha)	**754**	**851**

CA 31 (2001)

"Irrigation reduces yield variability"

But:

• Investment in irrigation equipment increases financial risk

• Severe droughts may cause higher damages to irrigating farmers than to non-irrigating farmers (due to water restrictions and more drought-sensitive varieties)

In 2002 and 2003, **yield varibility** in France was **greater for irrigated maize** than for non-irrigated maize.
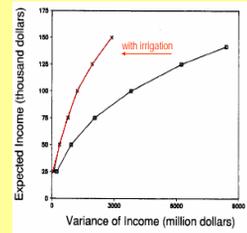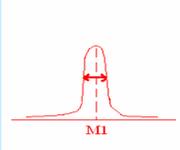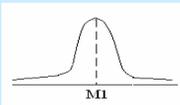

Vandeveer (1989)

Analysis of distribution of **profits** and **its moments of higher order** is important

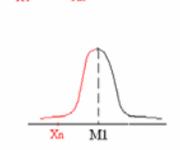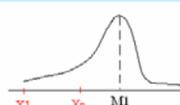## A moment-based approach : econometric estimation of distribution of profits

Second moment μ_2
VARIANCE
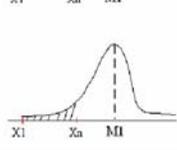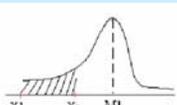
Third moment: μ_3
ASYMETRY

Fourth moment μ_4
DOWNSIDE RISK

Econometric estimation of moments of profit π

Antle (1983,1987), di Falco, Chavas (2006), Groom et al. (2007)

But: No French case study.

Expected utility of profits E(u) as a function of moments (μ) and inputs (X).

$$\underset{X}{Max} \; E[U(\pi)] = F[\mu_1(X), \mu_2(X)..., \mu_m(X)]$$

Marginal impact of inputs (e.g. irrigation) on moments

$$D_{ij} = \frac{\partial \mu_i}{\partial X_j}$$

The risk aversion coefficients can then be calculated as a function of moments

Arrow-Pratt $AP_j = f(U^1(\mu_1), U^2(\mu_{1j}))$

Downside risk $DS_j = f(U^1(\mu_1), U^3(\mu_{1j}))$

A French Case study
Preliminary results (work in progress)

Data

FADN Probe (« Sondes RICA »):

• more detailed data from the Farm Accountancy Data Network for cereals

• Maize production data for period 2002-2005

• for three French Regions: Midi Pyrénées, Centre, Ile de France

Main variables:

Yields, prices, cost of inputs, CAP payments

Example:
Gross margin 2005

variable	estimation	Std dev.
constant	710	2574
Irrigation	0.385	0.835
Fertilizer	2.277 **	0.760
Irr.squared	-9*10^(-5)*	4*10^(-5)
Fe squared	-2*10^(-6)	3*10^(-5)
Irr * Fer	1.7*10^(-4)	9*10^(-5)

R² ajust: 0.71

Results:

Irrigation and fertilizer **increase** siginifically the mean **gross margin**. This effect has **diminishing returns**

Other results (years 2002 to 2005): calculationsof D_{ij}

• The marginal impact of Irrigation (D_{ij}) is:
  - to increase the **variance of gross margin** GM,
  - to reduce **downside risk,**
  - to reduce the **asymetry** of distribution of GM.

⇨**Conclusion:** French farmers use irrigation to increase mean profits and to reduce the risk of undergoing very big losses. By doing so, they accept an increase in the variability of profits.

⇨**Perspectives:** If irrigation is used as a self-insurance mechanism, could it be replaced by appropriate insurance system in order to save scarce water?