Irrigation and risk management

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The role of irrigation in farmers’ risk management strategies: a French case study

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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.

"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)

Maize production in 2000

<table>
<thead>
<tr>
<th></th>
<th>Non irrigated</th>
<th>irrigated</th>
</tr>
</thead>
<tbody>
<tr>
<td>yield (€/ha)</td>
<td>1010</td>
<td>1307</td>
</tr>
<tr>
<td>CAP compensation (FF/ha)</td>
<td>300</td>
<td>448</td>
</tr>
<tr>
<td>Gross charges (FF/ha)</td>
<td>556</td>
<td>858</td>
</tr>
<tr>
<td>Gross margin (FF/ha)</td>
<td>754</td>
<td>851</td>
</tr>
</tbody>
</table>

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

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

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

$$\max_x E[U(\pi)] = F[\mu_1(X), \mu_2(X), ..., \mu_n(X)]$$

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

$$D_i = \frac{\mu_i}{E(X)}$$

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

Arrow-Pratt

$$AP_r = f(U^{-1}((\mu_1)), U^{-1}((\mu_2)))$$

Downside risk

$$DS_r = f(U^{-1}((\mu_1)), U^{-1}((\mu_2)))$$

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

<table>
<thead>
<tr>
<th>variable</th>
<th>estimation</th>
<th>Std dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>constant</td>
<td>710</td>
<td>2574</td>
</tr>
<tr>
<td>irrigation</td>
<td>0.385</td>
<td>0.835</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>2.277 **</td>
<td>0.760</td>
</tr>
<tr>
<td>Irr.squared</td>
<td>2*10^(-5)</td>
<td>3*10^(-5)</td>
</tr>
<tr>
<td>Fe squared</td>
<td>2*10^(-5)</td>
<td>3*10^(-5)</td>
</tr>
<tr>
<td>Irr * Fer</td>
<td>1.7*10^(-4)</td>
<td>9*10^(-5)</td>
</tr>
</tbody>
</table>

R² ajust: 0.71

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

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.