Linking marketing choices with farming practices of grain producers: a farm level modeling approach applied to the south-west of France

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Introduction

- CAP changes
- Increasing world commodity price volatility
- A few tools can help farmers to cope with this rising price risk:
  - revenue insurance
  - Marketing contracts
  - Farm level adjustments (on-farm strategies)
- Marketing contracts are playing an increasingly important role for EU farmers
- There is a need to understand how EU farmers will « react » to this new context
Introduction

• Theory of the firm under price uncertainty shows that risk averse farmers modify their production decision (Sandmo, 1971; Batra and Ullah, 1974)

• Holthausen (1979), Feder et al. (1980) proposed a « generalized » theory of production under price uncertainty (incorporate a forward market)...

• ...The production decision is not anymore subject to risk considerations. Production level is:
  – determined by the forward price
  – independant of the degree of risk aversion and subjective probability distribution of the uncertain price

• ...then, risk averse farmers should benefit from hedging instruments
objectives

• Based on this theoretical framework, we propose an applied study to investigate how price risk and risk aversion affect:
  – Production choices
  – Marketing choices
  – Links between production and marketing choices
• More precisely: could marketing alternatives help farmers, confronted to uncertainty, to use risky but environmentally-friendly practices?
Method

• We develop a multiperiodic mathematical programming model that incorporates the possibility of using marketing alternatives under price and output uncertainty.
The farm model

- Multiperiodic: planning horizon of 2 years
- 12 periods per year
- 6 crop activities
- 3 land types
  - 2 dry land types (clay muddy soil and sandy-clay soil)
  - 1 irrigated land
- 2 farming practices
- 4 pricing arrangements
- Specific states of nature for yield and price
The farm model

• Constraints on:
  – Crop rotation
  – Land resource
  – Stock constraints
  – Liquidity constraints (with an opportunity of short-term credit)
The farm model

• The farmer’s decision problem:
  – Production decisions:
    • crop mix
    • farming practices
  – Marketing decision: set of marketing contacts to select, conditional to states of nature of yield
  – Short-term financing decision
The farm model

• Objective function: discounted expected utility of the net profit
  – Risk preference: DARA-CRRA (power functional form of the utility function)
  – Time preference : (related to storage)
Empirical analysis and Data (Farming practices)

- Intensive crop management system (conventional)
- Crop management system inspired from Integrated Pest Management (IPM) (intergrated):
  - Pesticide and fertilizer reduction techniques
  - Lower production costs
  - Almost equal yields...
  - ...But higher yield risk
Empirical analysis and Data (marketing contracts)

• For each crop, there are different pricing arrangements:
  – K1: average sale price per quarter
  – K2: cash at harvest
  – K3: forward contracts
  – K4: post-harvest marketing contract (storage)
Empirical analysis and Data

- 3 farm types derived from a typology of large arable farm of the studied area (data from FADN)
- we selected the intermediate one (in terms of land size and irrigation density)
- Cost, return data and yield have been estimated according to the regional experts’ references database and direct interviews of expert
Risk assessment

- Procedure adapted from Richardson et al. (2000):
  - Normal distribution assumed (yield and price)
  - Historical intra-temporal correlations
  - Historical inter-temporal correlations
- Monte-carlo sampling to generate 20 states for each set of states of nature
(Preliminary) Results

• Case 1: a unique contract: cash at harvest contract (K2) = only production choices allow to mitigate risk

• Case 2: all contracts are available = the farmer is able to choose between marketing and technical choices to mitigate risk
(Preliminary) Results

- Simulation 1: increase in the coefficient of the relative risk aversion ($r$)
- Simulation 2: raise of the volatility of crop price: multiplication of the SD of each contract specific crop price by an expansion factor ($E$)

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<thead>
<tr>
<th></th>
<th>Simulation 1</th>
<th>Simulation 2</th>
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<tbody>
<tr>
<td>Case 1</td>
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<tr>
<td>Case 2</td>
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Effect of risk aversion and price risk on farming practices (comparison case 1 and 2)

- **Case 1:**
  - The higher the risk aversion of the farmer, the lower the Simulated Conversion Rate (SCR)
  - When price volatility increases, there is a decrease in the SCR for risk averse farmers ($r \geq 1.5$)

- **Case 2:** The drop in the SCR is less dramatic (go down to 40%)
Effect of risk aversion and price risk on crop mix (case 1)

- The higher the risk aversion of the farmer, the higher the crop diversification
- When price volatility increases, risk averse farmers diversify crop activities

<table>
<thead>
<tr>
<th>coefficient of relative risk aversion</th>
<th>0</th>
<th>0.9</th>
<th>1.1</th>
<th>1.5</th>
<th>2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expansion factor</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>simulated conversion rate (SCR)</td>
<td>100</td>
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</tbody>
</table>

|           | 100 | 100 | 100 | 100 | 100 | 100 | 92.7| 8.9 | 0   |
|           | 7.3 | 45.6| 52.4| 9.9 | 3.9 | 26.9| 49.2|     |     |
| conventional:                      |     |     |     |     |     |     |     |     |     |
| Durum wheat                        | 7.3 | 45.6| 52.4| 3.9 | 26.9| 49.2|     |     |     |
| Soft wheat                         |     |     |     |     |     |     |     |     |     |
| Irrigated corn                     | 15.1| 24  | 24  | 7.2 | 11  | 15  | 9.3 | 10.5|     |
| Dry corn                           | 2.4 | 9.6 | 9.3 | 12  | 1.3 |     |     |     |     |
| Sunflower                          |     |     |     |     |     |     |     |     |     |
| Rapeseed                           |     |     |     |     |     |     |     |     |     |

|           | 19  | 19  | 19  | 19  | 19  | 19  | 19  | 19  | 19  |
|           | 1.4 | 9.1 | 9.1 | 1.4 | 9.1 | 9.1 | 1.4 | 9.1 | 9.1 |
| integrated:                          |     |     |     |     |     |     |     |     |     |
| Durum wheat                        | 24  | 24  | 24  | 24  | 24  | 24  | 24  | 24  | 24  |
| Soft wheat                         | 24  | 24  | 24  | 24  | 24  | 24  | 24  | 24  | 24  |
| Irrigated corn                     | 17.6| 9.9 | 9.9 | 17.6| 9.9 | 9.9 | 17.6| 9.9 | 9.9 |
| Dry corn                           | 19  | 19  | 19  | 19  | 19  | 19  | 19  | 19  | 19  |
| Sunflower                          | 39.1| 57  | 57  | 57  | 57  | 57  | 57  | 57  | 57  |
| Rapeseed                           | 74  | 74  | 74  | 74  | 74  | 74  | 74  | 74  | 74  |

optimal cropping plan:
Effect of risk aversion and price risk on crop mix (comparison case 1 and 2)

- Crop mix chosen by a risk averse farmer (r=1.5) in case 2 is similar to the crop mix of a risk neutral farmer:

<table>
<thead>
<tr>
<th></th>
<th>case 1 (r=0)</th>
<th>case 2 (r=1.5)</th>
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</thead>
<tbody>
<tr>
<td>expansion factor (E)</td>
<td>1 (baseline)</td>
<td>2 3</td>
</tr>
<tr>
<td>durum wheat</td>
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<tr>
<td>soft wheat</td>
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<td>irrigated corn</td>
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<td>dry corn</td>
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<td>sunflower</td>
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<tr>
<td>rapeseed</td>
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<tr>
<td>durum wheat</td>
<td>57</td>
<td>57 57</td>
</tr>
<tr>
<td>soft wheat</td>
<td>24</td>
<td>24 24</td>
</tr>
<tr>
<td>irrigated corn</td>
<td>19</td>
<td>19 19</td>
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<tr>
<td>dry corn</td>
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<tr>
<td>sunflower</td>
<td></td>
<td></td>
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<tr>
<td>rapeseed</td>
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</table>

integrated:

optimal cropping plan (ha):

- Conventional:
  - Durum wheat: 30.6
  - Soft wheat: 17.5
  - Irrigated corn: 30.4

- Integrated:
  - Durum wheat: 15
  - Soft wheat: 24
  - Irrigated corn: 19
  - Dry corn: 24
  - Sunflower: 24
  - Rapeseed: 19
Marketing choices (case 2)

- When price risk becomes severe, quantities stored decrease while the hedge ratio increases
- e.g: marketing choices for the 2 main crops in year 1
Conclusion

• Sensibility analysis presented here shows how the model reacts to different values of the main parameters...

• No marketing tools to manage price risk (case 1):
  – Increasing risk aversion or price risk lead to:
    • A large switch towards risk-decreasing conventional farming practices
    • An increase in the crop diversification
    • Hardly risk averse farmers can manage partially price risk without any change to farming practices (but there is still change to production choices)

• Marketing contracts are available (case 2):
  – Increasing risk aversion or price risk lead to:
    • A decrease in the storage and an increase in the hedge ratio
    • A weaker decrease in the SCR
Conclusion

• In the study area, price risk level and risk aversion could actually play a role in the low adoption rate of environmentally-friendly farming practices...

• But marketing strategies could help to maintain the use of innovative techniques

• Production risk and marketing alternatives need to be jointly analysed to study the relevance of environmentally friendly technologies for farmers
Conclusion

• Labour constraints are not taken into account (favourable to the integrated practices)
• Further analysis is needed. Role of the other factors included in the model:
  – Liquidity and credit constraints
  – CAP change (SFP...)
  – Natural hedging (farmer’s expectations...)
• ...it could affect the adoption rate of hedging strategies obtained...and the production choices