Assessing farms risk profile through the estimation of factors affecting the probability of income reduction: the case of Italian dairy farm.

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Presentation outline

- Conceptual framework
  - EU Regulation
  - Technical problems to be solved

- Research question and objectives

- Data analysis, results and discussion
The IST under the new CAP
(Reg. EU 1305/2013)

• With the new CAP post-2013, the EU defines for the first time an European strategy for risk management.

• Article 36 – Risk management
• Article 39 – Income Stabilisation Tool

  • financial contributions to mutual funds, providing compensation to farmers for a severe drop in their income (drop exceeds 30%) calculated for the preceding three-year period or for the preceding five-year period excluding the highest and lowest entries (Olympic average)

• Intensity of contribution: 65% of mutual funds compensation.
Technical aspects to be solved

• Several authors stated that technical aspects strongly affect performance of insurance schemes
  • Atwood et al., 2003; Hennessy, 2009; Just and Weninger, 1999; Kerand Goodwin, 2000; Ramirez et al., 2003

• Quantification of reference income is a critical point in IST
  • Finger and El Benni (2014) stated that the use of the average income will cause biased estimates suggesting to observe income trend
  • Agristability income insurance introduces an adjustment of reference margin when a change of farm structure occurs.
Research Question

• Mutual fund would know:
  • Do structural changes are relevant in the definition of Reference Income (RI)?
  • What is the probability of a severe drop of farm income of their associated farm?

Objective

• Verify if structural changes significantly affect Reference income for Italian dairy farms case study.

• Suggest a policy approach for the definition of reference income

• Estimate how farm characteristics and agricultural policy scenario, are able to affect the probability of such income reduction.
Data

• Farm Data Accountancy Network (FADN) data of Veneto and Lombardia Regions ranging from 2008 to 2014.

• 85 specialised farms observed in the all period (595 obs.)

• Income definition
  • Consistent with EU Reg. and Dell’Aquila (2013), D’Auria et al (2013), the considered income is the Value Added (VA)

• Farms in the model
  • Each farm starting from 2011 has a RI
  • The final dataset starts from 2011 to 2014 with 340 obs.
Reference income definition - Methodology

- Consistent with Finger and El Benni (2014) we calculate reference income based on three years average.

- In order to estimate if structural change would affect the level of indemnification, we compute three type of RI:
  - Three years average income: \( RI \)
  - Three years adjusted over cultivated area: \( RI_{UAA} \)
  - Three years adjusted over livestock herd: \( RI_{LSU} \)

- Income variation it has been calculated as difference between RI and observed income in each year.

- Applying a *paired t-test* the existence of a significant difference among different methodology it has been estimated.
Reference income definition - Results

Percentage of observation with a income reduction over 30% for different methodology in the calculation of reference income*

<table>
<thead>
<tr>
<th></th>
<th>RI</th>
<th>RI_UAA</th>
<th>RI_LSU</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>4.7%</td>
<td>4.7%</td>
<td>5.9%</td>
</tr>
<tr>
<td>2012</td>
<td>1.2%</td>
<td>8.2%</td>
<td>2.4%</td>
</tr>
<tr>
<td>2013</td>
<td>14.1%</td>
<td>20.0%</td>
<td>23.5%</td>
</tr>
<tr>
<td>2014</td>
<td>12.9%</td>
<td>18.8%</td>
<td>34.1%</td>
</tr>
<tr>
<td>Total</td>
<td>8.2%</td>
<td>12.9%</td>
<td>16.5%</td>
</tr>
</tbody>
</table>

Paired t-test of income variation for different methodology in the calculation of reference income*

<table>
<thead>
<tr>
<th>Paired differences</th>
<th>Mean</th>
<th>SD</th>
<th>Mean SE</th>
<th>t</th>
<th>df</th>
<th>Sign.</th>
</tr>
</thead>
<tbody>
<tr>
<td>RI - RI_UAA</td>
<td>9573</td>
<td>41800</td>
<td>2267</td>
<td>4.22</td>
<td>339</td>
<td>0.000</td>
</tr>
<tr>
<td>RI - RI_LSU</td>
<td>23574</td>
<td>60731</td>
<td>3294</td>
<td>7.16</td>
<td>339</td>
<td>0.000</td>
</tr>
<tr>
<td>RI_UAA - RI_LSU</td>
<td>14001</td>
<td>74834</td>
<td>4058</td>
<td>3.45</td>
<td>339</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Reference Income adjustment based on variation of structural characteristics significantly affect the estimation of income variation in the observed period of time.

* RI: three years average income; RI_UAA: average income adjusted over cultivated area; RI_LSU: average income adjusted over livestock herd.
Income variation model - methodology

- Income variation has been coded as a variable with three \((y_i = 0, 1, 2)\) levels.
  - no income reduction \((j=0)\)
  - income reduction not exceeding 30% \((j=1)\)
  - income reduction above 30% \((j=2)\)

- The probability of each level has been estimated by mean of a multinomial logit model (Greene, 2000):
  - Topographic and climatic characteristics
  - Structural characteristics
  - Management strategies
  - Operational organisation
  - Past economic performance

\[
Prob(y_i = j) = \frac{\exp(\beta_j'X_i)}{\sum_{k=0}^{2} \exp(\beta_k'X_i)} \quad j=0,1,2
\]
## Descriptive Statistics

<table>
<thead>
<tr>
<th>Variables</th>
<th>Description</th>
<th>%</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Topographic and climatic characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hill</td>
<td>Farm located in hill area</td>
<td>10.6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mount</td>
<td>Farm located in mountain area</td>
<td>8.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>valley</td>
<td>Farm located in lowland area</td>
<td>81.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Structural characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>uaa</td>
<td>Average utilised agricultural area (UAA) in the reference period</td>
<td>37.2</td>
<td>42.4</td>
<td></td>
</tr>
<tr>
<td>lsu</td>
<td>Average livestock standard unit (LSU) in the reference period</td>
<td>142.8</td>
<td>128.0</td>
<td></td>
</tr>
<tr>
<td>lsu_change</td>
<td>Variation in LSU from reference period</td>
<td>12.6</td>
<td>33.5</td>
<td></td>
</tr>
<tr>
<td>lsu_ha</td>
<td>LSU per hectare in the reference period</td>
<td>4.7</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>lsu_ha_change</td>
<td>Variation in LSU per hectare from reference period</td>
<td>0.2</td>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td><strong>Management strategies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>young</td>
<td>Farm managed by young farmer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>no=0</td>
<td>92.9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>yes=1</td>
<td>7.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>external_labour</td>
<td>Prevalence of dependent worker</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>no=0</td>
<td>90.9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>yes=1</td>
<td>9.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>society</td>
<td>Farm managed as a society</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>no=0</td>
<td>58.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>yes=1</td>
<td>41.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lu</td>
<td>Number of labour unit</td>
<td></td>
<td>2.6</td>
<td>1.4</td>
</tr>
<tr>
<td>interest</td>
<td>Share of paid interest over revenue</td>
<td></td>
<td>0.1%</td>
<td>0.3%</td>
</tr>
</tbody>
</table>
## Descriptive statistics

<table>
<thead>
<tr>
<th>Variables</th>
<th>Description</th>
<th>%</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operational organisation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>uaa_owned</td>
<td>Share of owned UAA (%)</td>
<td>41.4%</td>
<td>37.0%</td>
<td></td>
</tr>
<tr>
<td>uaa_irrigated</td>
<td>Share of irrigated UAA (%)</td>
<td>69.8%</td>
<td>44.2%</td>
<td></td>
</tr>
<tr>
<td>reuses</td>
<td>Share of self-produced feed value (%)</td>
<td>36.1%</td>
<td>17.4%</td>
<td></td>
</tr>
<tr>
<td>concentrate</td>
<td>Expenditure for concentrate feed over 100 kg of milk produced</td>
<td>11.3</td>
<td>6.5</td>
<td></td>
</tr>
<tr>
<td>yield</td>
<td>Average production for LSU (100 kg)</td>
<td>43.7</td>
<td>13.0</td>
<td></td>
</tr>
<tr>
<td><strong>Past performance economic performance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>unit_revenue</td>
<td>revenue for each 100 kg of milk in the reference period</td>
<td>57.2</td>
<td>11.9</td>
<td></td>
</tr>
<tr>
<td>sd_va</td>
<td>Standard deviation of farm value added in the reference period</td>
<td>41,990.2</td>
<td>53,883.8</td>
<td></td>
</tr>
<tr>
<td>sd_va_ha</td>
<td>Standard deviation of farm value added per hectare in the reference period</td>
<td>1,521.7</td>
<td>2,290.2</td>
<td></td>
</tr>
<tr>
<td>sd_va_lsu</td>
<td>Standard deviation of farm value added per LSU in the reference period</td>
<td>315.9</td>
<td>250.4</td>
<td></td>
</tr>
<tr>
<td>subsidies</td>
<td>Average share of public payment over revenue in the reference period (%)</td>
<td>7.9%</td>
<td>5.7%</td>
<td></td>
</tr>
</tbody>
</table>
Income variation model - Estimates

Fit coefficient of estimated models

<table>
<thead>
<tr>
<th></th>
<th>RI</th>
<th>RI_UAA</th>
<th>RI_LSU</th>
</tr>
</thead>
<tbody>
<tr>
<td>McFadden (Pseudo-R²)</td>
<td>0.156</td>
<td>0.169</td>
<td>0.192</td>
</tr>
<tr>
<td>Correctly classified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y=0</td>
<td>65.0%</td>
<td>66.0%</td>
<td>62.8%</td>
</tr>
<tr>
<td>Y=1</td>
<td>57.9%</td>
<td>53.8%</td>
<td>70.3%</td>
</tr>
<tr>
<td>Y=2</td>
<td>46.4%</td>
<td>36.4%</td>
<td>51.8%</td>
</tr>
<tr>
<td>All sample</td>
<td>60.3%</td>
<td>57.1%</td>
<td>64.4%</td>
</tr>
</tbody>
</table>

*RI: three years average income; RI_UAA: average income adjusted over cultivated area; RI_LSU: average income adjusted over livestock herd.*
## Model Estimates

<table>
<thead>
<tr>
<th>Variables</th>
<th>Y=1 (income reduction &lt;=30%)</th>
<th>Y=2 (income reduction &gt;30%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T</td>
<td>P-val</td>
</tr>
<tr>
<td>intercept</td>
<td>-3.694</td>
<td>0.035</td>
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</table>

### Topographic and climatic characteristics

<table>
<thead>
<tr>
<th>Variables</th>
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<th>P-val</th>
<th>sig</th>
<th>T</th>
<th>P-val</th>
<th>sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>hill</td>
<td>-0.365</td>
<td>0.456</td>
<td></td>
<td>0.220</td>
<td>0.803</td>
<td></td>
</tr>
<tr>
<td>mount</td>
<td>-0.693</td>
<td>0.339</td>
<td></td>
<td>1.253</td>
<td>0.193</td>
<td></td>
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</table>

### Structural characteristics

<table>
<thead>
<tr>
<th>Variables</th>
<th>T</th>
<th>P-val</th>
<th>sig</th>
<th>T</th>
<th>P-val</th>
<th>sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>uaa</td>
<td>0.001</td>
<td>0.807</td>
<td></td>
<td>-0.005</td>
<td>0.589</td>
<td></td>
</tr>
<tr>
<td>lsu</td>
<td>0.000</td>
<td>0.941</td>
<td></td>
<td>-0.006</td>
<td>0.093 *</td>
<td></td>
</tr>
<tr>
<td>lsu_change</td>
<td>0.012</td>
<td>0.026 **</td>
<td></td>
<td>0.030</td>
<td>0.002 ***</td>
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</tr>
<tr>
<td>lsu_ha</td>
<td>0.142</td>
<td>0.073 *</td>
<td></td>
<td>0.043</td>
<td>0.737</td>
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<tr>
<td>lsu_ha_change</td>
<td>0.188</td>
<td>0.125</td>
<td></td>
<td>0.443</td>
<td>0.061 *</td>
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</table>

### Management strategies

<table>
<thead>
<tr>
<th>Variables</th>
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<th>P-val</th>
<th>sig</th>
<th>T</th>
<th>P-val</th>
<th>sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>young</td>
<td>0.872</td>
<td>0.233</td>
<td></td>
<td>2.162</td>
<td>0.012 **</td>
<td></td>
</tr>
<tr>
<td>external_labour</td>
<td>-0.447</td>
<td>0.388</td>
<td></td>
<td>-0.431</td>
<td>0.668</td>
<td></td>
</tr>
<tr>
<td>society</td>
<td>0.098</td>
<td>0.749</td>
<td></td>
<td>0.844</td>
<td>0.100 *</td>
<td></td>
</tr>
<tr>
<td>lu</td>
<td>-0.142</td>
<td>0.332</td>
<td></td>
<td>0.005</td>
<td>0.983</td>
<td></td>
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<tr>
<td>interest</td>
<td>-9.010</td>
<td>0.861</td>
<td></td>
<td>-31.140</td>
<td>0.704</td>
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### Operational organisation

<table>
<thead>
<tr>
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<th>P-val</th>
<th>sig</th>
<th>T</th>
<th>P-val</th>
<th>sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>uaa_owned</td>
<td>-0.093</td>
<td>0.816</td>
<td></td>
<td>-1.469</td>
<td>0.028 **</td>
<td></td>
</tr>
<tr>
<td>uaa_irrigated</td>
<td>-0.123</td>
<td>0.744</td>
<td></td>
<td>0.681</td>
<td>0.261</td>
<td></td>
</tr>
<tr>
<td>reuses</td>
<td>3.368</td>
<td>0.011 **</td>
<td></td>
<td>1.442</td>
<td>0.465</td>
<td></td>
</tr>
<tr>
<td>concentrate</td>
<td>0.146</td>
<td>0.000 ***</td>
<td></td>
<td>0.167</td>
<td>0.001 ***</td>
<td></td>
</tr>
<tr>
<td>yield</td>
<td>-0.009</td>
<td>0.490</td>
<td></td>
<td>-0.080</td>
<td>0.001 ***</td>
<td></td>
</tr>
</tbody>
</table>

### Past performance economic performance

<table>
<thead>
<tr>
<th>Variables</th>
<th>T</th>
<th>P-val</th>
<th>sig</th>
<th>T</th>
<th>P-val</th>
<th>sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>price</td>
<td>0.019</td>
<td>0.193</td>
<td></td>
<td>-0.030</td>
<td>0.190</td>
<td></td>
</tr>
<tr>
<td>sd_va_lsu</td>
<td>0.000</td>
<td>0.713</td>
<td></td>
<td>0.001</td>
<td>0.144</td>
<td></td>
</tr>
<tr>
<td>subsidies</td>
<td>1.785</td>
<td>0.655</td>
<td></td>
<td>3.206</td>
<td>0.466</td>
<td></td>
</tr>
</tbody>
</table>
Discussion on key variables

- Model’s prediction ability
  - Structural characteristics, management strategy and operational organisation contribute to the probability of income variation prediction

- In the case of Italian specialised dairy farm
  - Topographic and climatic attribute:
    - any effect → indoor production system
  - Structural characteristics:
    - Number of LSU: → lower probability for severe income reduction
    - Level of intensification: → increase the probability for a moderate income reduction
    - Structural change: → the increase of LSU and of intensification rise the probability of severe income reduction
  - Management strategy:
    - Farms lead by young farmers and organised in societal form shows a higher probability for severe income reduction
  - Operational organisation
    - Land ownership and animal productivity: → reduce the probability of severe income reduction
    - Feed intensification: → increase the probability of income reduction
    - Share of reuses: → increase the probability of moderate income reduction
Conclusions

- IST application
  - uncertainty relate to monitoring of individual incomes, control of strategic behavior
  - technical aspects strongly affect performance of insurance schemes
  - even if applied to specialised dairy farms, IST do not lead to a frequent indemnification

- Role of structural changes
  - Within the observed sample, the change in structural characteristics have a significant impact on the quantification of income variation
  - Income of Northern Italian dairy farms seems to be better interpreted if reference income is parametrized based on herd dimension
Conclusion

• At the moment there are few knowledge about factors affecting the probability of income drop under IST rules

• **Probability of income reduction**

• The capacity on interpretation of the estimated model
  • Limited in terms of interpretation
  • Useful in terms of classification

• The estimated model allow to individually evaluate income risk, reducing information asymmetries.

• The estimated model could be used to adjust average probability of income variation

• **Further research**

• Improvement could be obtained by the introduction of price expectation on futures market.
Thank you