Factors differentiating the level of crop insurance in Polish farms

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156th. EAAE seminar
Prospects for agricultural insurance in Europe
3-4 October, Wageningen
„...why farmers do not contract crop insurance policies as much as they should when considering the risk they face?”
[Bougherara 2016]

POLAND: legal obligation of insuring 50% of area, but only...

- 10,3% of insured farms,
- 23,88 % of insured area.
Aim of the study

Identification of determinants influencing Polish farmers decisions on insuring crops.
Field of observation and data

General population:

730 879 farms with standard output > 4 th. EUR

- FADN data individual farm records (2004-2013):
  - 11-12 th. observations for each year,
- Yield data (2004-2013),
- Farm characteristics data (2013),
- Use of FADN typology:
  - Economic size, Type of farming, FADN Region,
- Granivores and horticulture farms excluded,
- Sample size: 9 937 farms (2013),
Polish FADN, stratified sampling

Dimensions:
1. Region: 4 levels
2. Economic size: 6 levels
3. Farming type: 13 levels

Number of strata: $4 \times 6 \times 13 = 312$

Optimum allocation (Neyman’s method):

$$n_h = n \frac{N_h \sigma_h}{\sum_{k=1}^{L} N_k \sigma_k}$$

where: $n_h$ – sample size in strata $h$, $n$ – total sample size,
$N_h$ – population size in strata $h$, $\sigma_h$ – standard deviation in strata $h$, $L$ – number of strata.
Farm typology

Farm types:
- Cereal (TF 15)
- Mixed crop (TF 16)
- Cattle (TF 4)
- Mixed livestock (TF 7)
- Mixed (TF 8)

NOT INCLUDED:
- Granivores (TF 5)
- Horticultural (TF 2, TF 3)

Farm economic size:
- Very small <8 th. EUR SO
- Small 8-25 th. EUR SO
- Medium 25-50 th. EUR SO
- Large 50-250 th. EUR SO
- Very Large >250 th. EUR SO

FADN Regions:
Other considered determinants

• farmers education,
• farmers age,
• area of arable land,
• soil quality index (within the range 0.05-1.95),
• organic production system,
• intensity of production (value of inputs per ha),
• losses of yields experienced in last 9 years (40% drop below farm average for one of the main crops).
Methodology

\[
\ln \left( \frac{P(Y_i = 1)}{1 - P(Y_i = 1)} \right) = \alpha + \beta_1 x_{1i} + \cdots
\]

where:

\( Y_i \) - variable of purchasing crop insurance: 0 – not purchased, 1 – purchased,
\( \alpha \) - intercept
\( x_{1i}, \ldots, x_{ki} \) - values of the independent variables for the \( i-th \) farm,
\( \beta_1, \ldots, \beta_k \) - values of the coefficients for the respective independent variables.

The Horvitz-Thompson estimator was used to include information on number of farms represented by every farm in the sample.

Model estimation was performed in R environment with Tomas Lumley „survey” package.
Average marginal effect - example

\[
\ln \left( \frac{P(Y_i = 1)}{1 - P(Y_i = 1)} \right) = -6 + 0.5x
\]

Average marginal effect \( \sim 4 \) p.p.
# Model results - POLAND

<table>
<thead>
<tr>
<th>Variables</th>
<th>Estimate</th>
<th>Stand. error</th>
<th>t.value</th>
<th>p.value</th>
<th>Average marginal effects p.p.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>-3.67</td>
<td>0.24</td>
<td>-15.12</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Crop losses in last 9 years</td>
<td>0.58</td>
<td>0.13</td>
<td>4.37</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>FADN region (Wielkopolska i Śląsk)</td>
<td>0.69</td>
<td>0.12</td>
<td>5.95</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>FADN region (Mazowsze i Podlasie)</td>
<td>-0.65</td>
<td>0.14</td>
<td>-4.76</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>FADN region (Małopolska i Pogórze)</td>
<td>-0.99</td>
<td>0.18</td>
<td>-4.86</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Cattle farm (TF4)</td>
<td>-0.55</td>
<td>0.14</td>
<td>-3.84</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Mixed livestock farm (TF7)</td>
<td>-0.1</td>
<td>0.15</td>
<td>-0.71</td>
<td>0.479</td>
<td>-0.97</td>
</tr>
<tr>
<td>Cereal farm (TF15)</td>
<td>0.54</td>
<td>0.15</td>
<td>3.56</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Mixed crop farm (TF16)</td>
<td>0.04</td>
<td>0.16</td>
<td>0.22</td>
<td>0.827</td>
<td>0.34</td>
</tr>
<tr>
<td>Econ. farm size 8-25 th. EUR</td>
<td>0.85</td>
<td>0.17</td>
<td>4.91</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Econ. farm size 25-50 th. EUR</td>
<td>1.15</td>
<td>0.19</td>
<td>6.17</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Econ. farm size 50-250 th. EUR</td>
<td>1.33</td>
<td>0.21</td>
<td>6.41</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Econ. farm size &gt; 250 th. EUR</td>
<td>1.23</td>
<td>0.28</td>
<td>4.4</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Farmer second. or higher education</td>
<td>0.34</td>
<td>0.09</td>
<td>3.57</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Soil quality index [0,05-1,95]</td>
<td>0.6</td>
<td>0.15</td>
<td>3.98</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Arable land area [ha]</td>
<td>0</td>
<td>0</td>
<td>2.25</td>
<td>0.024</td>
<td>0.03</td>
</tr>
<tr>
<td>Inputs value per ha of AL[th. PLN]</td>
<td>0.23</td>
<td>0.06</td>
<td>4.01</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

*Note: The table may contain errors or be incomplete.*
### Regional Differentiation

<table>
<thead>
<tr>
<th>Region</th>
<th>„Pomorze i Mazury“ (785)</th>
<th>„Wielkopolska i Śląsk“ (790)</th>
<th>„Mazowsze i Podlasie“ (795)</th>
<th>„Małopolska i Pogórze“ (800)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share of farms using crop insurance [% of farms]</td>
<td>15,9</td>
<td>28,9</td>
<td>6,5</td>
<td>5,1</td>
</tr>
<tr>
<td>Area of the farm [average ha]</td>
<td>24,3</td>
<td>18,9</td>
<td>12,4</td>
<td>8,7</td>
</tr>
<tr>
<td>Economic farm size [average th. EUR]</td>
<td>15,7</td>
<td>17,1</td>
<td>5,4</td>
<td>3,3</td>
</tr>
<tr>
<td>Share of farms that experienced yield losses [%]</td>
<td>13,6</td>
<td>15,6</td>
<td>7,8</td>
<td>7,5</td>
</tr>
<tr>
<td>Soil quality index [average]</td>
<td>0,74</td>
<td>0,86</td>
<td>0,71</td>
<td>0,84</td>
</tr>
<tr>
<td>Intensity of crop production [average value of inputs PLN/ha]</td>
<td>1415</td>
<td>1656</td>
<td>1460</td>
<td>1456</td>
</tr>
<tr>
<td>Education of farmers [% secondary and higher education]</td>
<td>43,9</td>
<td>47,1</td>
<td>49,8</td>
<td>50,5</td>
</tr>
</tbody>
</table>
Regional models – economic farm size

Average marginal effects p.p.

Economic farm size [th. EUR of Standardt Output]

-5 0 5 10 15 20 25

8-25 25-50 50-250 >250

p-value < 0.1
Regional models – farm specialization

- Cattle farm (TF4)
- Mixed livestock farm (TF7)
- Cereal farm (TF15)
- Mixed crop farm (TF16)

Average marginal effects p.p.

Farm type

- „Pomorze i Mazury”
- “Wielkopolska i Śląsk”
- “Mazowsze i Podlasie”
- “Małopolska i Pogórze”

p-value < 0.1
Regional models – other factors

- Crop decrease in last 9 years
- Farmer secondary or higher education
- Soil quality index [0.05-1.95]
- Arable land area [ha]
- Inputs value [th. PLN/ha]

- p-value < 0.1
Conclusions 1

• Average uptake of insurance in Poland is still quite low,
• lack of effective policy instruments which might encourage farmers to use insurance,
• average insurance uptake in Poland is strongly differentiated between regions,
• in regions with higher share of bigger and commercially oriented farms the insurance uptake is greater,
Conclusions 2

• other determinants of insurance uptake:
  • economic farm size,
  • farm specialization,
  • crop loss experienced in the past,
  • farmers education,
  • intensity of farming,

• in regions with predominant share of relatively small, family farms the insurance uptake is low and its determinants cannot be clearly identified,
Conclusions 3

• Although level of crop insurance in Poland is really low it seems that farmers behave rationally. They insure crops in cases when the possible loss could significantly endanger financial situation of farm.